R. F. RINEHART
Academic Dean
Academic Dean

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Catalogue of
UNITED STATES NAVAL POSTGRADUATE SCHOOL

ACADEMIC YEAR·

1949 • 1950

POSTGRADUATE SCHOOL ANNAPOLIS, MARYLAND

NAV PERS 15779

CATALOGUE OF

U. S. NAVAL POSTGRADUATE SCHOOL

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ACADEMIC YEAR

1949 - 1950

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PART I

GENERAL

STAFF OF THE NAVAL POSTGRADUATE SCHOOL

Officers

H. A. Spanagel	R. Adm., USN (Ret.)	Superintendent
J. M. P. Wright	Capt. USN	Executive Officer

Aerological Engineering

W. E. Oberholtzer, Jr.	Capt. AEDO USN	Officer in Charge
P. T. Jorgensen	Lt. Cdr. AEDO USN	
M. C. Jack	Lt. Cdr. AEDO USN	
M. A. Eaton	Lieut. AEDO USN	
L. D. From	Ch. Aero. USN	

Aeronautical Engineering

W. W. Hollister	Cmdr. USN	Officer in Charge
V. C. Tompkins	Cmdr. USNR	

Applied Communications

W. L. Dye	Capt. USN	Officer in Charge
J. H. Fortune	Cmdr. USN	
A. P. Zavadil	Cmdr. USN	
R. S. Rankin	Lt. Cdr. USN	

Electronics Engineering

W. C. Schultz	Capt. USN	Officer in Charge
S. H. Walsh	Lt. Cmdr. USN	
G. J. Stetka	Lt. j.g. USN	

Naval Engineering

J. E. Fradd	Capt. USN	Officer in Charge
T. H. Brittan	Cmdr. USN	
J. P. Craft	Cmdr. USN	

Ordnance Engineering

E. K. Walker	Capt. USN	Officer in Charge
R. A. Thacher	Cmdr. USN	
C. W. Travis	Cmdr. USN	

G. C. Foltz	Lt. Cdr. USN.	Aide to Executive Officer
L. S. Helmeci	Lt. j.g. USN	Comm. Officer

CIVILIAN FACULTY

Glasgow, Roy S., B.S. in E.E., M.S., E.E.	Academic Dean
Root, Ralph E., B.S., M.S., Ph. D.	Senior Prof. of Mathematics (Emeritus)
Fowler, Harold E., AB.; B.L.S.	Librarian

Aerology

Duthie, William D., B.A., M.S., Ph. D.	Chairman; Prof. of Aerology
Haltiner, George J., B.S., Ph. M., Ph. D.	Assoc. Prof. of Aerology
Martin, Frank L., B.A., M.A., Ph. D.	Assoc. Prof. of Aerology

Aeronautics

Coates, Wendell M., A.B., M. Sc., D. Sc.	Chairman; Prof. of Aeronautics
Borg, Sidney F., B.S. in C.E., M.C.E.	Asst. Prof. of Aeronautics
Dennis, Ward B., B. Ac. E., M.S.E. (Ae).	Asst. Prof. of Aeronautics
Higgins, George J., B.S. in Eng. (Ae.E.), Ae.E.	Prof. of Aeronautics
Kahr, Charles H., B.S. (AeE), M.S.E. (Ae).	Asst. Prof. of Aeronautics
Kohler, Henry L., B.S., M.S., M.E.	Assoc. Prof. of Aeronautics
Meyer, Rudolph X., Dipl. Ing.	Asst. Prof. of Aeronautics
Rottmeyer, Earl, B.S.M.E., M.S.E. (Ae).	Asst. Prof. of Aeronautics
Vavra, Michael H., Dipl. Ing.	Assoc. Prof. of Aeronautics

Electrical Engineering

Terwilliger, Charles V.O., B.E., M.S. in E.E., Dr. Eng.	Chairman; Prof. of Electrical Engineering
Oler, Charles B., B.S., M.S.	Asst. Prof. of Electrical Engineering
Polk, Orval H., B.S. in E.E., E.E., M.S.	Assoc. Prof. of Electrical Engineering
Pula, Thaddens J., B.E.	Inst. of Electrical Engineering

Electrical Engineering (Con't)

Rothauge, Charles H., B.E., Dr.Eng.	Asst. Prof. of Electrical Engineering
Smith, W. Conley, B.S. in E.E., M.S.	Asst. Prof. of Electrical Engineering
Vivell, Allen, E., B.E., Dr. Eng.	Prof. of Electrical Engineering
Wheeler, Richard C.H., B.E., D. Eng.	Prof. of Electrical Engineering

Electronics and Physics

Frey, Austin R., B.S., S.M., Ph. D.	Chairman; Prof. of Physics
Bauer, Robert E., B.S.	Instr. of Electronics
Bauer, Wm. Malcolm, B.S., E.E., M.S., S.D.	Assoc. Prof. of Electronics
Chaney, Jessee G., A.B., M.A.	Prof. of Electronics
Cunningham, William P., B.S., Ph. D.	Prof. of Physics
Cooper, Paul E., B.S., M.S.	Assoc. Prof. of Electronics
Giet, G. Robert, A.B., E.E.	Prof. of Electronics
Goddard, Earl G., B.S. in E.E., M.A., E.E.	Asst. Prof. of Electronics
Healy, Daniel W., B.S., M.A. (on leave)	Asst. Prof. of Electronics
Hunter, George T., B.S., M.S., Ph. D.	Assoc. Prof. of Physics
Kalmbach, Sydney H., B.S., M.S.	Asst. Prof. of Physics
Kinsler, Lawrence E., B.S., Phd. D.	Assoc. Prof. of Physics
Koehler, Wilfert F., B.S., M.A.	Assoc. Prof. of Physics
Maling, Henry F., B.S., S.M., S.D.	Asst. Prof. of Electronics
Menneken, Carl E., B.S., M.S.	Assoc. Prof. of Electronics
Miller, Robert L., B. Ed., M.S.	Asst. Prof. of Electronics
Oleson , N.L., B.S., M.S., Ph. D.	Assoc. Prof. of Physics

Electronics and Physics (Con't.)

Roadstrum, William H., B.S. in E.E., M.S. in E.E.	Asst. Prof. of Electronics
Sheingold, Abraham, B.S., M.S.	Asst. Prof. of Electronics
Wilson, Robert D., B.S.	Asst. Prof. in Electronics

Mathematics and Mechanics

Church, W. Randolph, A.B., A.M., Ph. D.	Chairman; Prof of Math. & Mech.
Bleick, Willard E., M.E. Ph. D.	Assoc. Prof. of Math. & Mech.
Campbell, Richard C., B.S., A.M.	Asst. Prof. of Math & Mech.
Denbow, Carl H., S.S., S.M., Ph. D.	Assoc. Prof. of Math. & Mech.
Giarratana, Joseph, B.S., Ph. D.	Assoc. Prof. of Math. & Mech.
Jennings, Walter, B.A., B.S., M.A.	Asst. Prof. of Math. & Mech.
Lockhart, Brooks J., A.B., M.S., Ph. D.	Asst. Prof. of Math. & Mech.
Mewborn, A. Boyd, B.S., M.S., Ph. D.	Assoc. Prof. of Math. & Mech.
Pulliam, Francis M., B.A., M.A., Ph. D.	Asst. Prof. of Math. & Mech.
Rawlins, Charles H., Ph. B., A.M., Ph. D.	Prof. of Math. & Mech.
Torrance, Charles C., M.E., M.A., Ph. D.	Assoc. Prof. of Math. & Mech.

Mechanical Engineering

Kiefer, Paul J., A.B., B.S. in M.E., M.E.	Chairman; Senior Prof. of Mech. Eng.
Gatcombe, Ernest K., B.S. in M.E., M.S. in M.E. Ph. D.	Assoc. Prof. of Mech. Eng.
Kavanaugh, Dennis, B.S. in M.E.	Prof. of Mech. Eng.
Lee, George H., B.S., M.S. in Eng., Ph. D.	Assoc. Prof. of Mech. Eng.
Prowell, Roy W., B.S. in Indus. Eng'g., M.S. in M.E.	Asst. Prof. of Mech. Eng.
Wright, Harold M., B.S. in M.E., M.M.E.	Assoc. Prof. of Mech. Eng.

Metallurgy and Chemistry

Coonan, Fredrick L., A.B., M.S., D. Sc.	Chairman; Prof. of Metal. & Chem.
Buerger, Newton W., S.B., S.M., Ph. D.	Assoc. Prof. of Metal.
Clark, John R., B.S., Sc. D.	Assoc. Prof. of Metal.
Hering, Carl A., B.S. in Ch. E., M.S. in Eng.	Asst. Prof. of Chem. Eng.
Kinney, Gilbert F., A.B., M.S., Ph. D.	Assoc. Prof. of Chem. Eng.
Marshall, George D. Jr., B.S., M.S.	Assoc. Prof. of Metal.
McFarlin, George H., A.B., A.M.	Assoc. Prof. of Chemistry
Mebane, William M., B.S., M.S., Ph. D. (on leave)	Assoc. Prof. of Chemistry
Reynolds, Melvin F., B.S., M.S., Ph. D.	Assoc. Prof. of Chemistry

ACADEMIC ASSOCIATES

Aerological Engineering

William D. Duthie, B.A., M.S., Ph. D.	Prof. of Aerolgy

Aeronautical Engineering

Wendell M. Coates, A.B., M.Sc., D.Sc.	Prof. of Aeronautics

Applied Communications

G. Robert Giet, A.B., E.E.	Prof. of Electronics

Electronics Engineering

G. Robert Giet, A.B., E.E.	Prof. of Electronics

General Line School

Frank E. La Cauza, B.S. in E.E., M.S. in E.E., A.M.	Prof. of Electrical Eng.

Naval Engineering

Orval H. Polk, B.S. in E.E., E.E., M.S.	Assoc. Prof. of Electrical Eng.

Ordnance Engineering

Richard C. H. Wheeler, B.S., D.Eng.	Prof. of Electrical Eng.

TERM WEEKLY CALENDAR 1949 - 1950

Week	Summer	Fall	Winter	Spring
1st	July 25	Oct. 10	Jan. 2	Mar. 20
2nd	Aug. 1	Oct. 17	Jan. 9	Mar. 27
3rd	Aug. 8	Oct. 24	Jan. 16	Apr. 3
4th	Aug. 15	Oct. 31	Jan. 23	Apr. 10
5th	Aug. 22	Nov. 7	Jan. 30	Apr. 17
6th	Aug. 29	Nov. 14	Feb. 6	Apr. 24
7th	Sept. 5	Nov. 21	Feb. 13	May 1
8th	Sept. 12	Nov. 28	Feb. 20	May 8
9th	Sept. 19	Dec. 5	Feb. 27	May 15
10th	Sept. 26	Dec. 12	Mar. 6	May 22
11th	Oct. 3	------	Mar. 13	------

Christmas Leave Period: December 17, 1949 - January 2, 1950

Field Trips: May 30 - July 8, 1949

Intersessional Leave Period: July 10 - July 24, 1949

The following days have been designated holidays and no classes will be held:

5	September	1949	Monday
11	November	1949	Friday
24	November	1949	Thursday
25	December	1949	Sunday
1	January	1950	Sunday
22	February	1950	Wednesday
30	May	1950	Tuesday
4	July	1950	Tuesday

POSTGRADUATE SCHOOL TRAINING PROGRAM

The general plan for officer education is set forth in the Bureau of Naval Personnel Manual: Chapter D Section 3.

D-1301

(1) FUNCTIONS.--The postgraduate School, with headquarters at the Naval Academy, Annapolis, is established for maintaining courses of instruction for the advanced education and training of commissioned officers in such general or technical subjects as the Secretary of the Navy may prescribe. Postgraduate courses are conducted both at the Postgraduate School and at private institutions. Whether conducted at the Postgraduate School or elsewhere, all postgraduate courses are under the cognizance of and directed by the superintendent of the Postgraduate School.

(3) SELECTION OF OFFICERS.--Selection of officers applying for postgraduate instruction is made by boards appointed by the Chief of Naval Personnel. The courses available, the conditions of eligibility, and other pertinent data are published annually in Bureau of Naval Personnel circular letters.

(6) POSTGRADUATE SCHOOL CATALOGS.--Detailed information relative to the curriculum for each postgraduate course is given in the annual postgraduate school catalog. This catalog is given wide distribution and should be studied by officers interested in postgraduate training.

THE REGULATIONS GOVERNING THE POSTGRADUATE SCHOOL

The Naval Postgraduate School was established in 1909 as an activity of the U. S. Naval Academy by direction of the Navy Department. The increasing emphasis placed on the advanced technical training of Naval Officer Personnel by the Navy Department, during the past several years, is reflected by the passage of three acts by congress affecting the academic and physical stature of the Postgraduate School. These three acts authorized the School to grant advanced degrees in engineering and related fields, created the civilian position of academic dean and established the U. S. Naval Postgraduate School as a separate naval activity.

The first act passed by congress, designed to emphasize the academic level of the School, was Public Law 250, 79th Congress, 1st Session. This act authorized the School to grant Bachelor's, Master's and Doctor's degrees in engineering and related subjects. Although this authority was not exercised for two years after passage of the act, suitable courses of study were instituted as rapidly as possible. Public Law 402, 79th Congress, 2nd Session, created the civilian position of Academic Dean. This position was established to insure continuity of academic policy.

The United States Naval Postgraduate school was established as a separate naval activity by Public Law 303, 80th Congress, 1st Session. This act authorized the Secretary of the Navy to establish the School for the advanced training of commissioned officers of the Navy and Marine Corps. The military command of the School was vested in an officer of the Regular Navy, not below the rank of captain, to be appointed by the Secretary of the Navy, to serve as Superintendent. The Secretary of the Navy was also authorized to employ at the School, under the direction of the Superintendent, a civilian faculty of adequate size to meet the objective of the School. The two previous acts were amended to apply to the newly formed U. S. Naval Postgraduate School.

In addition to the School at Annapolis, which is primarily for engineering student officers, the Superintendent is responsible for an Intelligence School in Washington, D.C. and General Line Schools at Newport, R.I. and Monterey, Calif.

MISSION

From the above regulations, the mission of the Postgraduate School is taken to be:

TO CONDUCT AND DIRECT THE ADVANCED INSTRUCTION AND TRAINING OF COMMISSIONED OFFICERS IN THE PRACTICAL AND THEORICAL DUTIES IN ORDER TO MEET THE REQUIREMENTS OF THE NAVY.

TASK

TASK: 1. To provide the advanced education necessary for selected groups of officers to develop proficiency in design, inspection and installation of material, with attendant research problems, and to provide practical and theoretical training necessary for officers to serve in special branches of the Naval service by:

(a) Planning, conducting and maintaining suitable postgraduate courses at the U. S. Naval Postgraduate School, Annapolis, Maryland, and at selected civilian institutions.

(b) Organizing, planning and directing General Line Curricula at Newport, Rhode Island, and Monterey, California.

(c) Organizing, planning and directing the conduct of a Naval Intelligence course at Naval School (Naval Intelligence), Receiving Station, Washington, D. C.

REGULATIONS GOVERING THE AWARD OF ADVANCED DEGREES

1. Master's or Doctor's degrees in engineering or related fields may be awarded by the Superintendent of the United States Naval Postgraduate School upon recommendation of the Faculty based upon satisfactory completion of a course of advanced study arranged by a Curriculum Committee, approved by the Academic Council (consisting of the Academic Dean, the Director of the School of Engineering and the civilian chairmen of the Academic Departments) and complying with the regulations set forth hereunder.

REQUIREMENTS FOR THE MASTER'S DEGREE

(a) The Master s degree in engineering and related fields is awarded for the successful completion of a curriculum which complements the basic scientific education of a student and which has been approved by the Academic Council as meriting a degree, provided the student exhibits superior scholarship, attains scientific proficiency, and meets additional requirements as stated in the following paragraphs

(b) Since curricula serving the needs of the Navy ordinarily contain undergraduate as well as graduate courses a minimum of two academic years of residence at the U. S Naval Postgraduate School is normally required. With the approval of the Academic Council, the time of residence may be reduced in the case of particular students who have successfully pursued graduate study at other education institutions. In no case will the degree be granted for less than one academic year of residence at the U. S. Naval Postgraduate School

(c) A curriculum leading to a Master's degree shall comprise not less than forty-eight term hours (32 semester hours) of work that is clearly of graduate level, and shall contain a well-supported major together with cognate minors. At least six of the term hours shall be in advanced mathematics. Proposed program shall be submitted to the cognizant Department Chairman for review and approval. If the program is satisfactory to the Department Chairman it shall be forwarded by him to the Academic Council for final action.

(d) To become a candidate for the Master's degree the student shall have completed at least three quarters of the graduate credit courses of his curriculum with a quality point rating in them of not less than 1.75 as defined in the section on scholarship.

(e) To be eligible for the Master's degree, the student must attain a minimum average quality point rating of 2.0 in all graduate credit courses; 1.5 in all of his other courses. In special cases, under very extenuating circumstances, small deficiencies from the figures noted in paragraphs (d) and (e) may be waived at the discretion of the Academic Council.

(f) A reasonable proportion of the graduate work leading to the Master's degree shall comprise research and a thesis reporting the results obtained. The thesis topic may be selected by the student, subject to the approval of the cognizant Department Chairman. The completed thesis must indicate ability to perform independent work and to report on it in a scholarly fashion. The thesis, in final form, will be submitted to the cognizant Department Chairman for review and evaluation. Upon final approval of the thesis by the Department Chairman, the student shall be certified as eligible for final examination.

(g) If the thesis is accepted the candidate for the degree shall take a final oral examination the duration of which will be approximately one hour. An additional comprehensive written examination may be required at the discretion of the cognizant Department Chairman. Not more than one-half of the oral examination shall be devoted to questions directly related to the candidate's thesis topic; the remainder to the candidate's major and related areas of study.

(h) With due regard for the above requirements, the Academic Council will decide whether to recommend the candidate to the Superintendent of the U. S. Naval Postgraduate School for the award of the Master's Degree.

REQUIREMENTS FOR THE DOCTOR S DEGREE

(a) The Doctor s degree in engineering and related fields is awarded as a result of very meritorious and scholarly achievement in a particular field of study which has been approved by the Academic Council as within the purview of the U S Naval Postgraduate School. A candidate must exhibit faithful and scholarly application to all prescribed courses of study, achieve a high level of scientific advancement and establish his ability for independent investigation, research and analysis. He shall further meet the requirements described in the following paragraphs

(b) Any program approved as leading to the Doctor s degree shall require the equivalent of at least three academic years of study beyond the undergraduate level, and shall meet the needs of the Navy for advanced study in the particular area of investigation. At least one academic year of the doctorate work shall be spent at the U S. Naval Postgraduate School.

(c) A student seeking to become a candidate for the Doctorate shall hold a Bachelor s degree from a college or university, based on a curriculum that included the prerequisites for full graduate status in the department of his major study or he shall have pursued successfully an equivalent course of study The student shall submit his previous record to the Academic Council, via the Academic Dean, for final determination of the adequacy of his preparation.

(d) Upon favorable action by the Academic Council the student will be notified that he may request the Chairman of the Department of his major subject to form a doctorate committee. This chairman will specify one or more minor subjects and with the chairmen of the corresponding departments will nominate a doctorate committee consisting of five or more members, at least three of whom are under different departments. The chairman of the department of the major subject will submit to the Academic Council for its approval the choice of minor fields and the names of the faculty members nominated for the doctorate committee.

(e) After a sufficient period of study in his major and minor fields the student shall submit to qualifying examinations, including tests of his reading knowledge of foreign languages. The selection of these languages depends on the field of study. The minimum is a reading knowledge of German and a second language to be suggested by his doctorate committee and approved by the Academic Council. The language examinations will be conducted by a committee specially appointed by the Academic Council The other qualifying examinations will cover material previously studied in his major and minor fields; they will be written and oral and will be conducted by the doctorate

committee. The members of the Academic Council or their delegates may be present at the oral examinations. The doctorate committee will report the results of the qualifying examinations to the Academic Council for consideration and upon approval the student becomes a candidate for the doctorate. The qualifying examinations are ordinarily not given before the completion of the first year of residence at the U. S. Naval Postgraduate School; they must be passed successfully at least two years before the degree is granted.

(f) Upon successful qualification as a candidate the doctorate committee will propose a further program of study. This program must be approved by the Academic Council.

(g) The distinct requirement of the doctorate is the successful completion of an original, significant and scholarly investigation in the candidate's major area of study. The results of the investigation, in the form of a publishable dissertation, must be submitted to the Academic Council at least two months before the time at which it is hoped the degree will be granted. The Academic Council will select two or more referees who will make individual written reports on the dissertation. Lastly, the Academic Council will vote upon the acceptance of the dissertation.

(h) After the approval of the dissertation and not later than two weeks prior to the award of the degree the candidate will be subject to written and oral examinations in his major and minor subjects. Written examinations will be conducted by the department having cognizance of the particular subjects. The occasions and scope of all examinations will be arranged by the doctorate committee after consultation with the departments concerned and the members of the Academic Council. The doctorate committee will notify the Academic Council of the time of the oral examination and will invite their attendance or that of their delegates. The committee will also invite the attendance of such other interested persons as it may deem desirable. In this oral examination approximately one half of the allotted time will be devoted to the major subject and one half to the minor subjects. The doctorate committee will submit the results of all examinations to the Academic Council for their approval.

(i) With due regard for all of the above requirements the Academic Council will decide whether to recommend the candidate to the Superintendent of the U.S. Naval Postgraduate School for the award of the doctorate.

SCHOLARSHIP STANDARDS

(1) Student officers enrolled in the U. S. Naval Postgraduate School will be rated academically by Quality Points attained, and this rating will be determined in the following manner:

Grade	Quality Points
A	3.0
B	2.0
C	1.0
D	0
X	-1.0

Quality Point Rating shall be calculated by dividing the sum of the products of assigned quality points and credit hours in each course by the total number of credit hours obtained. Each one hour lecture or recitation period per week or each two hour laboratory or P. W. period will count as one credit hour.

(2) Each student officer enrolled in a three year Postgraduate School curriculum on 1 July, 1948 and thereafter will be required to attain the following minimum quality point ratings or be subject to separation from the curriculum in which he is enrolled:

(a) At the end of the fourth term, 1.40
(b) At the end of the eighth term, 1.70

(3) No student officer will be recommended for acceptance by a civilian institution unless he has attained a quality point rating of 1.70 or better at the time he is scheduled for transfer, except in special circumstances.

(4) Each student officer enrolled in a two year certificate curriculum must attain a minimum quality point rating of 1.0 by the end of the fourth term or be subject to separation from the curriculum in which he is enrolled. Certificate curricula are the ones that do not lead to an advanced degree.

(5) To be eligible for a certificate of completion of any curriculum, each student officer must attain a quality point rating of 1.0 or better.

DEFINITIONS

Before setting forth the duties of the various members of the Staff, certain terms as used at the Postgraduate School are defined.

A CURRICULUM is a general program of study which extends over one or more years.

A SUBJECT is the organized body of knowledge such as Mathematics, Mechanics, Chemistry, etc. forming a study. For the purpose of brevity each subject is assigned a letter.

A COURSE is a subdivision of a SUBJECT, selected and arranged for a particular purpose. For purposes of brevity each COURSE is assigned the letter of the SUBJECT to which it pertains together with its own individual number, such as M-101, M-312, etc. Each subject matter designation will be followed by a course number symbol containing three digits, the first digit indicating the field within the subject, the second digit to be zero unless needed to further qualify the field, and the third digit to indicate a sequence in the field. The second digit may be important in designating courses of different levels, such as is at present found in Mathematics.

A GROUP is a collection of student officers who receive the same instruction. For purposes of brevity each GROUP is assigned a letter. These should not be confused with letters assigned SUBJECTS.

A SCHEDULE OF INSTRUCTION shows the COURSES taken by any one GROUP during each term.

STUDENT OFFICERS OF THE POSTGRADUATE SCHOOL

Board of officers meeting yearly in Washington select student officers to take the curriculums at the Postgraduate School in Annapolis, the combined Naval Engineering and Naval Construction curriculum at Mass. Inst. of Tech., the Civil Engineering curriculum at Rensselaer Polytechnic Inst., the Law, Textile Engineering, Business Administration, Personnel Administration and Training, Advanced Management, and Industrial Management curriculums at various other universities. The organization for those selected who are to commence their postgraduate instruction at the institutions away from Annapolis is shown in Part IV. For those to enter the Postgraduate School at Annapolis the organization is as shown below.

ORGANIZATION

Group Designation	Year of Instruction		
A	1st	Postgraduate School	Aeronautical Eng.
A2	2nd	Postgraduate School	" " "
A3	3rd	U. of Michigan	" "
AE	1st	Postgraduate School	" " Elec.
AE2	2nd	Postgraduate School	" " Elec.
AE3	3rd	Postgraduate School	" " Elec.
AC3	3rd	Cal Tech & U. of Minn.	Compressibility
AF3	3rd	Princeton U.	Flight Analysis
AJ3	3rd	Cal Tech & U. of Minn.	Jet Propulsion
AP3	3rd	M. I. T.	Propulsion Systems
AR	1st	Postgraduate School	Aero. Eng. Arm.
AR2	2nd	Postgraduate School	" " "
AR3	3rd	M. I. T.	" " "
AS3	3rd	Cal Tech & U. of Minn.	Structures
AT3	3rd	Rensselaer Poly. Inst.	Gas Turbines

C11	1st	Postgraduate School	App. Communications
E	1st	Postgraduate School	Electronics Eng.
E2	2nd	Postgraduate School	Electronics Eng.
E3	3rd	Postgraduate School	" "
EW3	3rd	U. C. L. A.	Electronics Eng.
M	1st	Postgraduate School, Monterey	Aerological Eng.
M2	2nd	Postgraduate School, Monterey	Aerological Eng.
MS	1st	Postgraduate School, Monterey	Aerological Eng. (Spec.)
MA	1st	Postgraduate School, Monterey	Applied Aerology "
N3	3rd	Postgraduate School	Electronics Eng.
NA	1st	Postgraduate School	" " (Applied)
NA2	2nd	Postgraduate School	" " "
NC	1st	Postgraduate School	Chemical Eng.
NC2	2nd	Lehigh Univ.	" "
NC3	3rd	Lehigh Univ.	" "
NH	1st	Postgraduate School	Mechanical Eng.
NH2	2nd	Postgraduate School	" "
NH3	3rd	Postgraduate School	" "
NJ	1st	Postgraduate School	Nav. Eng. (Gas Turbine)
NJ2	2nd	Postgraduate School	" " " "
NJ3	3rd	Selected Univ.	" " " "
NL	1st	Postgraduate School	Electrical Eng.
NL2	2nd	Postgraduate School	" "
NL3	3rd	Postgraduate School	" "
NM	1st	Postgraduate School	Metallurgical Eng.
NM2	2nd	Carnegie Tech.	" "
NM3	3rd	Carnegie Tech.	" "

NN3	3rd	Argonne Laboratories	Nuclear Power Eng.
NP	1st	Postgraduate School	Petroleum Eng.
NP2	2nd	Univ. of Calif.	" "
NP3	3rd	Univ. of Calif.	" "
O	1st	Postgraduate School	Ord. Eng. (General)
O2	2nd	Postgraduate School	" " "
O3	3rd	Purdue Univ.	" " "
OC	1st	Postgraduate School	Ord. Eng. (Fire Con)
OC2	2nd	M. I. T.	" " " "
OC3	3rd	M. I. T.	" " " "
OE	1st	Postgraduate School	Ord. Eng. (Aviation)
OE2	2nd	Postgraduate School	" " "
OE3	3rd	M. I. T.	" " "
OG	1st	Postgraduate School	Ord. Eng. (Guided Mis. Guidance)
OG2	2nd	Postgraduate School	Ord. Eng. (Guided Mis. Guidance)
OG3	3rd	Institution Selected	Ord. Eng. (Guided Mis. Guidance)
OJ	1st	Postgraduate School	Ord. Eng. (Jet Prop)
OJ2	2nd	Postgraduate School	" " " "
OJ3	3rd	Institution Selected	" " " "
OM	1st	Postgraduate School	Ord. Eng. (Metall.)
OM2	2nd	Postgraduate School	" " "
OM3	3rd	Carnegie Tech.	" " "
OP	1st	Postgraduate School	Ord. Eng. (Chemical)
OP2	2nd	Postgraduate School	" " "
OP3	3rd	Lehigh U.	" " "
OR	1st	Postgraduate School	Ord. Eng. (GM-Electronic)
OR2	2nd	Postgraduate School	" " " "
OR3	3rd	M. I. T.	" " " "

OT	1st	Postgraduate School	Ord. Eng. (Mech-Elec Propulsion)
OT2	2nd	Postgraduate School	" " " "
OT3	3rd	M. I. T.	" " " "
OW	1st	Postgraduate School	Ord. Eng. (Subsurface)
OW2	2nd	Postgraduate School	" " "
OW3	3rd	U.C.L.A.	" " "
OX	1st	Postgraduate School	Ord. Eng. (Sp. Phys)
OX2	2nd	M. I. T.	" " " "
OX3	3rd	M. I. T.	" " " "
RM	1st	Postgraduate School	Advanced Science Group (Mathematics)
RM2	2nd	Selected Univ.	" " "
RM3	3rd	Selected Univ.	" " "
RC	1st	Postgraduate School	Advanced Science Group (Chemistry)
RC2	2nd	Selected Univ.	" " "
RC3	3rd	Selected Univ.	" " "
RX	1st	Postgraduate School	Advanced Science Group (Physics)
RX2	2nd	Selected Univ.	" " "
RX3	3rd	Selected Univ.	" " "
RZ	1st	Postgraduate School	Radiological Defense (Engineering)
RZ2	2nd	University of Calif.	" " "
RZ3	3rd	University of Calif.	" " "

OFFICIALS IN CHARGE OF THE PRESENTATION OF CURRICULA OF POSTGRADUATE STUDENT OFFICER GROUPS AT UNIVERSITIES

GROUP	UNIVERSITY	IN CHARGE
A3 Aero. Eng.	Univ. of Michigan	Prof. E. W. Conlon
AF3 Aero. Eng.	Princeton U.	Prof. E. C. Perkins
AC3 AJ3 Aero. Eng. AS3	Cal. Inst. Tech.	Prof. E. E. Sechler
AC3 AJ3 Aero. Eng. AS3	Univ. of Minn.	Prof. J. D. Ackerman
AP3 Aero Eng. Prop. Syst.	M.I.T.	Prof. C. F. Taylor
AR3 Aero. Eng. Arm.	M. I. T.	Prof. J. S. Newell
AT3 Aero. Eng. (Gas Turb)	R. P. I.	Prof. N. P. Bailey
EW3 Electronic Eng.	U. C. L. A.	Prof. V. O. Knudson
NB Const. Eng.	M. I. T.	Capt. J. M. Farrin, Jr.
NC Chemical Eng.	Lehigh Univ.	Prof. H. A. Neville
NJ Jet Propulsion	To be selected	
NM Metallurgical Eng.	Carnegie Inst. Tech.	Asso. Prof. J. W. Ludewig
NP Petroleum Eng.	Univ. of Calif.	Prof. L. C. Uren
O3 Ord. Eng. General	Purdue U.	Prof. H. A. Boltz
OC2, OC3 Ord. Fire Con.	M. I. T.	Prof. H. L. Hazen
OE3 Ord. (Aviation)	M. I. T.	Prof. J. S. Newell
OG3 GM guidance	M. I. T.	Prof. C. S. Draper
OG3 GM guidance	Johns Hopkins	Prof. W. B. Kouwenhoven
OJ2 Ord. Jet Prop.	Cal. Inst. Tech.	Prof. E. E. Sechler
OJ2 Ord. Jet Prop.	Rensselaer Poly I.	Prof. N. P. Bailey
OM2, OM3 Ord. Metallurgy	Carnegie Inst. Tech.	Asso. Prof. J. W. Ludewig
OP2, OP3 Ord. Explosives	Lehigh University	Prof. H. A. Neville
OR2, OR3 Ord. Elect.	M. I. T.	Prof. E. A. Guillemin
OT2, OT3 Ord. Mech-El Prop.	M. I. T.	Prof. J. C. Hunsaker

GROUP	UNIVERSITY	IN CHARGE
OW2, OW3 Ord. Sound	U. C. L. A.	Prof. V. O. Knudson
OX2, OX3 Ord. Sp. Physics	M. I. T.	Prof. N. H. Frank
RZ2 Atomic Emergy Eng.	Univ. of Calif.	Prof. Loeb
ZCP Cinenotography	Univ. of So. Calif.	Capt. B. K. Culver
ZG Civil Eng.	Rensselaer Poly. I.	Capt. M. T. Farrar
ZH Law	Georgetown Univ.	Office of J A G
ZH Law	George Washington U.	" " " " "
ZI Naval Intelligence	Anacostia, D. C.	Capt. E. T. Layton
ZK Advanced Management	Harvard U.	Capt. C. J. Bonney
ZKH Bus. Admin.	Harvard Univ.	Capt. C. J. Bonney
ZKS Bus. Admin.	Stanford Univ.	Capt. R. K. Davis
ZM Textile Eng.	Lowell Institute	- - - - - - - - -
ZO Oceanography	Scripps Institute	Capt. L. C. Grannis
ZP Personnel Man. & Tr.	Ohio State	Capt. D. F. McLean
ZP Personnel Man. & Tr.	Stanford Univ.	Capt. R. K. Davis
ZP Personnel Man. & Tr.	Northwestern Univ.	Capt. E. R. Gardiner
ZT Management & Industrial Eng.	R. P. I.	Capt. M. T. Farrar
ZU Religion	Various	----------

PART II

CURRICULA FOR STUDENT OFFICERS COMMENCING POSTGRADUATE INSTRUCTION AT THE POSTGRADUATE SCHOOL, ANNAPOLIS.

AEROLOGICAL ENGINEERING AND APPLIED AEROLGY CURRICULA AT MONTEREY, CALIFORNIA.

AEROLOGICAL ENGINEERING CURRICULUM
M - groups

Objective

To prepare officers:

(a) To become competent aerological officers,

(b) To improve the methods of forecasting weather,

(c) To investigate and participate in the solution of any problems involving atmospheric conditions such as (1) visibility (2) turbulence (3) aircraft icing (4) ballistic winds and densities (5) micro-meteorology, etc.

First Year - M

Summer Term

Ma-101	Ord. Differential Equations	5-0
Mr-211	Weather Maps and Codes	2-9
Ph-196	General Physics	5-1
La-101 201	German or Russian	2-0
		14-10

Fall Term

Ma-102	Series & Vector Algebra	5-0
Mr-212	Surface Weather Map Analysis	1-12
Mr-210	Introduction to Synoptic Meteorology	5-0
La-102 202	German or Russian	2-0
		13-12

Winter Term

Ma-103	Funct. of Sev. Var. & Vect. Anal	5-0
Mr-213	Surface Weather Map Analysis	0.9
Mr-411	Thermodynamics of Meteorology	5-2
Mr-510	Climatology	2-0
La-103 203	German or Russian	2-0
SL-101	New Weapons Develpment	0-1
		14-12

Spring Term

Ma-134	Vector Mechanics and Numerical Methods	4-0
Mr-214	Weather Analysis and Forescasting	2-9
Mr-321	Dynamic Meteorology I	3-0
Mr-412	Physical Meteorology	3-0
La-104 204	German or Russian	2-0
SL-102	New Weapons Development	0-1
		14-10

Interessional Field Trip

Second Year - M 2

Summer Term

Ma-135	Partial Differential Equations & Introduction to Statistics	4-0
Mr-221	Weather Analysis and Forecasting	2-9
Mr-228	Southern Hemisphere and Tropical Meteorology	2-0
Mr-322	Dynamic Meteorology II	3-0
La-105 205	German or Russian	2-0
		13-9

Fall Term

Ma-331	Statistics	4-2
Mr-222	Weather Analysis & Forecasting	0-12
Mr-229	Selected Topics in Applied Meteorology	2-0
Mr-323	Dynamic Meteorology III (Turbulence & Diffusion)	3-0
La-106 206	German or Russian	2-0
		11-14

Winter Term

Mr-223	Advanced Weather Analysis and Forecasting	0-9
Mr-110	Radiological Defense	2-0
Mr-410	Meteorological Instruments	2-2
Mr-422	The Upper Atmosphere	5-0
*Mr-921	Thesis	2-0
La-107 207	German or Russian	2-0
SL-101	New Weapons Development	0-1
		11/13-12

Spring Term

Mr-224	Advanced Weather Analysis and Forecasting	0-15
Mr-225	Upper Air Analysis	0-10
Mr-420	Wave and Swell Forecasting	2-1
flMr-810	Seminar	2-0
*Mr-922	Thesis	4-0
La-108 208	German or Russian	2-0
SL-102	New Weapons Development	0-1
		6/8-27

*Taken only by candidates for the master's degree.
flOmitted by candidates for the master's degree.

APPLIED AEROLOGY CURRICULUM

MA-groups

Objective

To prepare officers to become competent aerological officers.

One Year - MA

Summer Term			Fall Term		
Ma-161	Algebra Trigonometry & Analytic Geometry	5-0	Ma-162	Introduction to Calculus	5-0
Mr-201	Weather Maps and Codes	2-12	Mr-202	Surface Weather Man Analysis and Forecasting	2-12
Mr-200	Introduction to Synoptic Meteorology	3-0	Mr-301	Synoptic Meteorology	5-0
Ph-190	Introduction to Physics	3-0	Mr-402	Meteorological Charts and Diagrams	3-0
	Total	13-12		Total	15-12

Winter Term			Spring Term		
Mr-203	Weather Analysis and Forecasting	2-12	Mr-110	Radiological Defense	2-0
Mr-302	Synoptic Meteorology	5-0	Mr-204	Advanced Weather Analysis Forecasting	0-15
Mr-410	Meteorological Instruments	2-2	Mr-205	Upper Air Analysis	0-10
Mr-403	Physical Meteorology & Physical Oceanography	4-0	Mr-404	Wave, Swell and Surf Forecasting	0-2
SL-101	New Weapons Development	0-1	SL-102	New Weapons Development	0-1
	Total	13-15		Total	2-28

SPECIAL AEROLOGICAL ENGINEERING CURRICULUM
MS - Groups

Objective

To permit specially selected aerological officers who have previously completed a short war-time curriculum:

(a) To acquire the necessary theoretical and partical training for advanced work in the field of meteorology.

(b) To acquaint these officers with the latest developments in meteorology and special weapons.

(c) To give these officers an opportunity to qualify for a Master of Science Degree.

Curriculum begins in January

Winter Term

Ma-103	Funct. of Sev. Var. & Vect. Anal.	5-0
Mr-411	Thermodynamics of Meteorology	5-2
Mr-510	Climatology	2-0
SL-101	New Weapons Development	0-1
		12-3

Spring Term

Ma-134	Vector Mechanics and Numerical Methods	4-0
Mr-214	Weather Analysis and Forecasting	2-9
Mr-321	Dynamic Meteorology I	3-0
Mr-412	Physical Meteorology (optional)	3-0
SL-102	New Weapons Development	0-1
		12-10

Second Year

Summer Term

Ma-135	Partial Differential Equations & Introduction to Statistics	4-0
Mr-221	Weather Analysis & Forecasting	2-9
Mr-228	Southern Hemisphere & Tropical Meteorology	2-0
Mr-322	Dynamic Meteorology II	3-0
		11-9

Fall Term

Ma-311	Statistics	4-2
Mr-222	Weather Analysis & Forecasting	0-12
Mr-229	Selected Topics in Applied Meteorology	2-0
Mr-323	Dynamic Meteorology III (Turbulence and Diffusion)	3-0
		9-14

Winter Term

Mr-110	Radiological Defense	2-0
Mr-223	Advanced Weather Analysis & Forecasting	0-9
Mr-422	The Upper Atmosphere	5-0
Mr-921	Thesis	2-0
SL-101	New Weapons Development	0-1
		9-10

Spring Term

Mr-224	Advanced Weather Analysis and Forecasting	0-15
Mr-225	Upper Air Analysis	0-10
Mr-420	Wave and Swell Forecasting	2-1
Mr-922	Thesis	4-0
SL-102	New Weapons Developments	0-1
		6-27

AERONAUTICAL ENGINEERING CURRICULA

Objective

The general objective of the aeronautical engineering curricula is to provide officers with advanced aeronautical engineering knowledge to meet the technical requirements of the Navy in this field. Specifically, these curricula are designed to cover the fundamental and advanced theories of mathematics, mechanics, electricity, metallurgy, structural analysis, aerodynamics and dynamics as they concern the particular field of aeronautical engineering, aeronautical armament, and aeronautical electricity.

AERONAUTICAL ENGINEERING CURRICULUM

Consists of two years of study at the Postgraduate School followed by one year at a civilian engineering school. Satisfactory completion normally leads to the award of a graduate degree in aeronautical engineering. The curriculum is the same for all officers during the first two years but specialization to a limited extent is permitted during the final year's work. Curricula for the third year at the various civilian institutions are arranged to provide emphasis on such fields as aircraft structural analysis, aircraft propulsion systems, compressibility, pilotless aircraft, aircraft performance, as well as general aeronautical engineering.

Curriculum Designation - "A"
for officers entering July 1949.

(1) Summer Term

Ma-101	Ordin. Diff. Equat's.	5-0
Mc-101	Plane Dynamics I	3-0
Mc-801	Statics of Structures	2-0
Ch-121	Genl. and Petroleum Chemistry	4-2
Mt-201	Introd. Phys. Metallurgy	3-2
		17-4

(2) Fall Term

Ae-100	Basic Aerodynamics	3-4
Ma-102	Series & Vector Algebra	5-0
Mc-102	Plane Dynamics II	3-0
Me-500	Strength of Materials	3-0
Me-601	Materials Testing	0-2
Mt-202	Ferrous Metals	3-2
Ae-001	Lecture-Aeron.	-
		17-8

(3) Winter Term

Ae-121	Technical Aerodyn.	3-2
Ae-201	Airc. Stress Analysis	4-2
Ma-103	Funct. of Sev. Var. & Vect.	5-0
EE-111	Fundamtls. of Elect Eng.	3-2
Mt-203	Phys. Metallurgy	2-2
SL-101	Lecture-New Weapons	
		17-8

(4) Spring Term

Ae-131	Aerody. Perform.	4-2
Ae-202	Airc. Stress Ana. II	4-2
EE-231	AC Circuits-DC Mach.	3-2
Ma-104	Part. Diff. Equations	5-0
Ma-201	Graph & Mech. Comp.	0-2
SL-102	Lecture-New Weap.	
		16-8

Summer, June-July 1950 - Six weeks.

Intercessional period in the field at aviation activities.

Second Year

For group entering July 1948 and group entering July 1949.

Curriculum Designation - "A2"

(5) Summer Term

Ae-203	Airc. Stress Analysis III	4-0
Ae-311	Aircraft Design I	2-4
Ae-501	Hydro - Aero Mech. I	4-0
Me-131	Eng. Thermo.	4-2
EE-731	Power Electronics	3-2
		17-8

(6) Fall Term

Ae-132	Flight Analysis	3-2
Ae-204	Stress Analysis IV	4-0
Ae-312	Airplane Design II	2-4
Ae-502	Hdro-Aero Mech. II	4-0
Me-132	Eng. Thermo.	3-2
Ae-001	Lecture-Aero.	
IE-101	Lecture-Indus. Org.	
		16-8

(7) Winter Term

Ae-503	Compressability	4-0
Ae-141	Aircraft Dynamics I	3-4
Ae-321	Adv. Aircraft. Struct.	4-0
Ae-411	Aircraft Eng.	3-2
Ch-521	Chemistry Plastics	3-2
SL-101	Lecture-New Weap. Dev.	
IE-103	Lecture-Indust. Org.	
		17-8

(8) Spring Term

Ae-142	Airc. Dynamics II	3-4
Ae-421	Airc. Propuls.	3-2
Mc-311	Vibrations	3-2
*ME-632	Exper. Stress Anal.	2-2
Ae-431	Int. Flow in Aircraft Eng.	4-0
SL-102	Lecture New Weap.	
		15-10

*Propulsion group takes Ch-571 Physical Chemistry (3-2) in place of ME-632 this term.

Summer Period spent in a civilian institution summer course in industrial engineering.

Third and last year aeronautical engineering will be conducted by a civilian institution.

Aeronautical Engineering (Armanent)

Curriculum

This curriculum consists of two years of study at the Postgraduate School followed by one year at the Massachusetts Institute of Technology. Satisfactory completion of this curriculum normally leads to the award of a graduate degree. This curriculum is designed to cover electrical, aeronautical and mechanical engineering subjects and related mathematics, metallurgy, electronics and ordnance courses. The third year at M.I.T. majors in guided missile electronic controls, and fire control systems.

Curriculum Designation "AR". For officers entering July 1949.

(1) Summer Term		(2) Fall Term	
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Circuits	3-4
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vec. Algebra	5-0
Mc-101 Plane Dynamics I	3-0	Mc-102 Plane Dynamics II	3-0
Mc-801 Statics of Structures	2-0	ME-500 Strgth. of Materials	3-0
Ch-101 Chem. General Inorganic	3-2	Ae-100 Basic Aerodyn.	3-4
		Ae-001 Lecture Aeron.	
	16-6		17-8

(3) Winter Term		(4) Spring Term	
EE-451 Transformers & Synchros	2-2	EE-455 Syn. Mach's. & Ind. Mot.	2-2
Ma-103 Functs of Sev. Var.	5-0	Ma-104 Part. Diff. Eq's.	5-0
Mt-201 Phys. Metallurgy-Intro.	3-2	Mt-202 Phys. Metal. Ferrous	3-2
Ae-201 Stress Analysis I	4-2	Ae-202 Aero. Stress Anal. II	4-2
Ae-121 Technical Aerodyn.	3-2	Ae-136 Aircraft Perform.	3-2
SL-101 Lecture New weap. Dev.		SL-102 Lecture New weap.	
	17-8		17-8

Six weeks intersessional period in the field.

Second Year

For group entering July 1948 and July 1949

Curriculum Designation "AR2"

(5) Summer Term

EE-551 Transm. Lines & Filtrs.	3-2
Ma-155 Advcd. Topics Math.	3-0
EE-751 Electronics	3-4
Ae-311 Aircraft Design	2-4
Ae-501 Hydro-Aero Mech. I	4-0
	15-10

(6) Fall Term

EE-755 Electronic Controls & Measurement	3-4
Mc-401 Ext. Ballistics	3-0
Ma-401 Mechan. Computers	2-2
Ma-106 Comp. Var. & LaPlace Tr.	4-0
Ae-502 Hydro-Aero Mech. II	4-0
IE-101 Lecture-Indus. Org.	
Ae-001 Lecture-Aeron.	
	16-6

(7) Winter Term

EE-671 Transients	3-4
Mc-402 Dyn. of Rigid Bodies	3-0
Or-404 Guid. Miss. Guidance	2-0
Ae-503 Compressibility	4-0
Ae-146 Airc. Dynamics	3-2
SL-101 Lecture-New Weap. Dev.	
IE-103 Lecture-Indus. Org.	
	15-6

(8) Spring Term

EE-753 Electronics	1-2
EE-672 Servo Mech.	3-4
Es-456 Introd. to Radar (Airborn)	2-2
Mt-203 Physical Metallurgy	2-2
Mc-201 Methods in Dynamics	2-2
Or-405 Guid. Missl. Guidance	1-0
SL-102 Lecture New Weap. Dev.	
	11-12

Third Year at M.I.T.

AERONAUTICAL ENGINEERING (ELECTRICAL) CURRICULUM

This curriculum consists of three years at the Postgraduate School. Satisfactory completion normally leads to the award of a graduate degree in electrical engineering. The curriculum is designed to provide major emphasis on electricity and is supported by aeronautics, mathematics, metallurgy, electronics and mechanics. The objective of this curriculum is to provide electrical engineers with a good understanding of aeronautical engineering.

Curriculum Designation "AE"

For officers entering July 1949.

"AE"

(1) Summer Term

Ma-101	Ord. Diff. Equatn's.	5-0
EE-171	Elect. Circts. & Flds.	3-4
Mc-101	Plane Dynamics I	3-0
Mc-801	Statics of Structures	2-0
Ch-101	Chem.General Inorganic	3-2
		16-6

(2) Fall Term

Ma-102	Series & Vec. Algebra	5-0
EE-271	AC Circuits	3-2
Mc-102	Plane Dynamics II	3-0
Me-500	Strgth-Materials	3-0
Ae-100	Basic Aerodyn.	3-4
Ae-001	Lect. Aeron.	
IE-101	Lect. Ind. Org.	
		17-6

(3) Winter Term

Ma-103	Funct. Sev. Var. & Vects.	5-0
EE-272	AC Circuits	2-2
Mt-201	Phys. Metall. Introd.	3-2
Ae-201	Aeron. Stress Anal. I	4-2
Ae-121	Tech. Aerod. I	3-2
SL-101	Lect. New Weap. Dev.	
		17-8

(4) Spring Term

Ma-104	Part. Diff. Eqts.	5-0
EE-371	D.C. Mach.	3-2
Mt-202	Phys. Metall.-Ferrous	3-2
Ae-202	Aeron. Stress Anal. II	4-2
Ae-136	Airc. Perform.	3-2
SL-102	Lect. New Weap. Dev.	
		18-8

Six weeks intersessional period in the field at an aviation test activity.

Second and Third year curricula same as for officers entering in July 1948.

Second Year

Curriculum Designation "AE2"

For officers entering July 1948.

(5) Summer Term

Ma-105	Fourier Series & B.L. Prob.	4-0
EE-471	Transfrmrs., Asymchro. & Synchro. Mach.	3-4
Ae-311	Aircraft Design	2-4
Ae-203	Airc. Stress Anal. III	4-0
Ae-501	Hydro Aero Mech. I	4-0
		17-8

(6) Fall Term

Ma-106	Comp. Var. & LaPlace Trans	4-0
EE-472	Syn. Machines	3-4
EE-971	Elect. Semin.	1-0
Ch-521	Chem. Plastics	3-2
Ae-502	Hydro Aero. Mech. II	4-0
IE-101	Lect. Ind. Org.	
Ae-001	Lect. Aeron.	
		15-6

(7) Winter Term

EE-571	Transm. Lines & Filtrs.	3-4
EE-771	Electronics	3-2
EE-971	Elect. Seminar	1-0
Es-256	Introduction to Radar App. of Vac. Tubes	2-0
Ae-503	Compressibility	4-0
Ae-146	Aircraft Dynam.	3-2
SL-101	Lect. New Weap. Dev.	
IE-103	Lect. Indust. Org.	
		16-8

(8) Spring Term

EE-772	Electronics	3-2
EE-971	Elect. Semin.	1-0
Es-226a	Pulse Circuits	2-1
Mt-203	Physical Metallurgy	2-2
Mc-201	Methods Dynamics	2-2
Ma-201	Graph. & Mech. Comp.	0-2
IE-104	Lect. Indust. Organ.	
SL-101	Lect. New Weap. Dev.	
		10-9

Interessional period of four weeks in an electrical test activity.

Third Year

At Postgraduate School for officers entering July 1948. Curriculum Designation "AE3".

(9) Summer Term

EE-671	Transients	3-4
EE-871	Electrical Machine Design	4-0
Es-431	Radar System Eng.	3-3
	Thesis	0-6
		10-13

(10) Fall Term

EE-672	Servo. Mechanisms	3-4
EE-872	Elect. Mach. Des.	4-0
EE-971	Elect. Semin.	1-0
Es-432	Radar System Eng.	3-6
Ae-002	Aeron. Lecture	0-2
	Thesis	0-3
		11-15

(11) Winter Term

EE-873	Elect. Mach. Des.	4-0
EE-971	Elect. Seminar	1-0
IE-103	Lecture-Indust. Org.	
	Thesis	0-10
		5-10

(12) Spring Term

EE-971	Elect. Sem.	1-0
Es-536	Counter measures	2-3
	Thesis	-10
		3-13

Third Year

At Postgraduate School for Group entering July 1947.
Curriculum Designation "AE3".

(9) Summer Term

EE-873	Elect. Mach. Des.	4-0
EE-772	Electronics	3-2
Es-441	Introd. to Radar	2-2
	Thesis	0-6
		9-10

(10) Fall Term

EE-971	Elect. Sem.	1-0
EE-672	Servo Mechanisms	3-4
Ae-002	Lect. Aeron.	0-2
	Thesis	0-8
		4-14

(11) Winter Term

At a field activity concerned with development and research of aviation electrical equipment.

(12) Spring Term

Ae-003	Lecture-Aeron.	0-2
EE-971	Electrical Seminar	1-0
	Thesis	0-10
		1-12

AERONAUTICAL ENGINEERING THIRD YEAR CURRICULA AT CIVILIAN INSTITUTIONS

AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Aircraft Propulsion Systems--"AP3"

FALL TERM	Hours/Week	SPRING TERM	Hours/Week
2.213 Gas Turbines	3 - 0 - 9	2.214 Gas Turbines	3 - 0 - 9
2.791 Intern. Comb. Engs.	3 - 0 - 6	2.792 I. C. Engines	3 - 0 - 6
10.70 Princ. of Combust.	3 - 0 - 6	16.56 Jet Engines	3 - 0 - 9
16.105 Applied Aerodyn.	3 - 0 - 6	Thesis	15
Thesis	10		48
	49		

AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Jet Propulsion - "AJ3"	Hrs./Wk.	Compressibility - "AC3"	Hrs./Wk.
AE-260 Research in Aeronaut.	15	AE-260 Research in Aeron.	15
AE-261 Hydrodyn. Comp. Fluids	10	AE-261 Hydrodyn. of Comp. Fld.	10
AE-270 Elasticity-Aeronautics	6	AE-266 Theoret. Aerodynamics	9
AE-272 Precisions Measurements	3	AE-270 Elasticity-Aeronautics	6
AE-281 Jet Propulsion Systems	12	AE-271 Vibration & Flutter	6
AE-282 Jet Laboratory	3	AE-272 Precision Measurements	3
AE-290 Aeronautics Seminar	1	AE-290 Aeronautics Seminar	1
	50		50

Structures - "AS3"	Hours/Week
AE-254 Advcd. Airplane Des.	4
AE-257 Engin. Math. Princps.	9
AE-260 Research in Aeronautics	15
AE-270 Elasticity-Aeronautics	6
AE-271 Vibration & Flutter	6
AE-272 Precision Measurements	3
AE-274 Aero-elasticity	6
AE-290 Aeronautics Seminar	1
	50

AT THE UNIVERSITY OF MICHIGAN

Aeronautical Engineering -"A3"

FALL TERM	Credit Hrs.		Credit Hrs.
Ae-116 Advcd. Fluid Mechs.	3	Ae-162 Analytical Research	3
Ae-133 Advcd. Structures	3	Ae-202 Compressible Fluids	3
Ae-172 Instrument & Research	3	*Ae-165 Aircraft Propulsion	3
*Ae-118 Exper. Aerodynamics	2	*Ae-106 Dynamics of Aircraft	3
*Ae-174 Nuclear Energy Prop.	3	*Ae-173 Instrumtn. & Research	3
*EM-131 Vibration Analysis	3	*Ae-176 Nuclear Energy	3
Research & thesis		*EM-124 Applied Elasticity	3
		*EM-132 Dynamics	2
		Research & Thesis	

*These are elective courses. Total credit hours scheduled per term-12.

AT THE UNIVERSITY OF MINNESOTA

Aeronautical Engineering - "A3"

1st Quarter		Credit Hrs.	2nd Quarter		Credit Hrs.
Ae-201	Aerodynamics	3	Ae-202	Aerodynamics	3
Ae-116	Stress Analysis	3	Ae-117	Stress Analysis	3
*ME-157	Turbines & Jets	3	*ME-259	Turbine Fuels & Comb.	4
*ME-134	Thermodynamics	3	*Ae-110	Vibration & Flutter	3
	Thesis	6	*ME-129	Vibration Engineering	3
				Thesis	5/6

3rd Quarter		Credit Hrs.
Ae-204	Supersonic Aerodyn. Lab.	5
Ae-118	Advcd. Stress Analysis	3
*Ae-240	Dynamics of Structures	3
*Ae-220	Perform. Hi-Speed Airc.	3
*ME-232	Advcd. Fluid Dynamics	3
	Thesis	5

*These are elective courses. Total hours per week required-15.

AT RENSSELAER POLYTECHNIC INSTITUTE

Gas Turbine Propulsion Systems - "AT3"

FALL TERM		Credit Hrs.	SPRING TERM		Credit Hrs.
G12:30	Thermody. Hi-vel. Flow	3	G12:40	Turbine & Jet Cycles	3
G 1:12	Intern. Aerodyn.& Jets	3	G 1:13	Dynamics & Stab. of Airc.	4
G12:41	Gas Turb. Comb & Stab.	3	G16:67	Nuclear Physics	2
G 4:52	Chem. of Combustion	3	G12:99	Thesis	6
G13:62	Hi-Temp. Metallurgy	3			
		15			15

AT PRINCETON UNIVERSITY

Aircraft Performance and Flight Analysis - "AF3"

1st Semester		2nd Semester	
AE-565	Airplane Dynamics	AE-566	Airplane Dynamics
AE-583	Advcd. Airpl. Perform.	AE-564	Jet Propulsion
AE-563	Jet Propulsion	AE-570	Analytical Engineering
AE-569	Analytical Engineer	AE-	Elective Course
	Thesis		Thesis

AERONAUTICAL ENGINEERING (ARMAMENT) THIRD YEAR CURRICULUM AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Curriculum commencing in the fall 1949 for officers who commenced their Postgraduate training in July 1947-"AR3".

FALL TERM (1949)	Hours/Week
6.20 Electronics Controls	3-0-6
6.605 Servomechanisms	3-0-6
16.15 Stab. & Control Missles	3-0-6
16.43 Fire Control Inst. Lab.	0-3-5
Thesis	0-6-0
	41

SPRING TERM (1950)	Hours/Week
6.606 Servomechanisms	3-3-6
16.44 Fire Control Instr.	4-0-8
16.46 Fire Cont. Inst. Lab.	0-3-5
Thesis	0-18-0
	50

Curriculum commencing in the fall 1950 for officers who commenced their Postgraduate training in July 1948-"AR3".

FALL TERM (1950)	Hours/Week
16.40 Space Kin. & Gyro. Theory	3-0-6
16.15 Stab. & Cont. Airc. Ad	3-0-6
16.41 Introd. to Fire Control	3-0-6
16.43 Fire Cont. Instrum. Lab.	0-3-5
16.39 Autom. Cont. Equip. Airc.	3-0-6
Thesis	0-6-0
	50

SPRING TERM (1951)	Hours/Week
16.44 Fire Cont. Instrum.	4-0-8
16.46 Fire Cont. Instrum. Lab.	0-3-5
Thesis	0-30-0
	50

APPLIED COMMUNICATIONS CURRICULUM C-11

OBJECTIVE

To prepare selected officers of the Navy:

(a) By a thorough operational knowledge of communications, to assist the Naval Communication Service in its functions as an indispensible accessory of Command.

(b) To be competent tactical officers, and to better perform duties of the Line.

(c) To be competent supervisors over the service operation of all types of apparatus utilized by the Naval Communication Service.

(d) To perform various administrative duties of the Naval Communication Service.

Summer Term		
Co-101	Typing & Radio Code	0-4
Co-110	Communication Procedure	2-2
Co-120	Basic Nav. Comm. Instruc.	2-1
Co-202	Tactics	2-2
Co-210	Corr. Course in Strategy & Tactics	-
Es-186	Fund. of Radio Comm.	4-4
Es-281	Electronics Fund.	2-2
		11-16

Fall Term		
Co-102	Radio Code & Procedure	0-4
Co-111	Teletype, Append. to Comm. Inst.	2-1
Co-121	Basic Rapid Comm. Plan	2-2
Co-203	Tactics	2-2
Co-210	Corr. Course in Strategy & Tactics	-
Es-283	Vacuum Tube Circuits	4-4
Es-786	R.F. Energy Trans.	4-2
		14-15

Winter Term		
Co-103	Visual & Voice Proc.	0-3
Co-112	Intern. & Comm. Comm.	1-1
Co-122	Basic Rapid Comm. Plans; Type & Task Force Comm. Plan	2-3
Co-204	Tactics	2-2
Co-210	Corr. Course in Strategy & Tactics	-
Es-283	Vacuum Tube Circuits	4-4
Es-286	Pulsing & H.F. Circuits	2-2
SL-101	New Weapon Develop.	**0-1
		11-16

Spring Term		
Co-104	Comm. & Other Nav. Organ.	2-1
Co-113	Correspondence & Mail	1-0
Co-114	Crypto Systems Instruc.	0-2
Co-123	Amphibious Comm. Plan	1-3
Co-205	Tactics	2-2
Co-210	Corr. Course in Strategy & Tactics	-
Es-386	Trans. & Receivers	3-3
Es-586	Special Systems	3-3
SL-101	New Weapon Develop.	**0-1
		12-15

**Lecture course.

ELECTRONICS ENGINEERING

OBJECTIVE

To give the student a thorough practical and theoretical training in electronics engineering in preparation for future duties involving the development and use of electronics equipment and systems in the Naval Establishment.

FIRST YEAR (E1)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series and Vector Algebra	5-0
Es-111 Electricity (D.C.)	4-4	Es-112 Electricity (A.C.)	4-3
Es-211 Electron Tubes & Circuits	2-3	Es-212 Electron Tubes & Circuits	2-3
Ph-211 Optics	3-0	Ph-212 Phys. Optics & Dynamics	3-3
		IE-101 Industrial Engineering	0-1
	14-7		14-10

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Es-113 Circuit Analysis & Meas.	3-3	Es-114 Circuit Analysis & Meas.	3-3
Es-213 Electron Tubes & Circuits	4-4	Es-214 Electron Tubes & Circuits	4-3
Ph-113 Dynamics	3-0	Ph-311 Electrostatics & Magnetostatics	3-0
SL-101 New Weapons	0-1	SL-102 New Weapons	0-1
IE-103 Industrial Engineering	0-1	IE-104 Human Engineering	0-1
	15-8		15-8

SECOND YEAR (E2)

Summer Term		Fall Term	
Es-621 Electromagnetics	3-0	Es-622 Electromagnetics	4-0
EE-314 A.C. & D.C. Machines	3-4	EE-672 Servomechanisms	3-4
*Ph-421 Fundamental Acoustics	3-0	*Ph-422 Applied Acoustics	3-0
Es-225 Electron Tubes	3-6	Es-126 Radio Freq. Measurements	2-6
	12-10		12-10

SECOND YEAR (E2) (Cont'd.)

Winter Term		Spring Term	
Es-623 Electromagnetics	4-0	Es-624 Electromagnetics	3-0
Es-121 Adv. Circuit Theory	3-2	Es-122 Adv. Circuit Theory	3-2
*Ph-423 Underwater Acoustics	2-3	Es-226 U.H.F. Tubes	4-3
Es-321 Radio Systems	3-3	Es-322 Radio Systems	3-3
	12-8		13-8

*Aviator members of group take: Ph-410 Sound 3-0 (Summer Term)
Ae-100 Basic Aerodynamics 3-4 (Fall Term)
Ae-121 Technical Aerodynamics 3-2 (Winter Term)

THIRD YEAR (E3)

Summer Term		Fall Term	
Es-736 Antennas, Trans. Lines	3-3	Es-531 Special Systems	3-3
Es-133 Adv. Circuit Theory	3-0	Es-134 Adv. Circuit Theory	3-0
Es-431 Radar System Eng.	3-3	Es-432 Radar System Eng.	3-6
Es-333 Radio Systems	2-3	Es-831 Thesis Seminar	2-0
	11-9		11-9

Winter Term	Spring Term	
This term is spent in an industrial plat or electronics laboratory, such as Bell Telephone Co., R.C.A., or General Electric Co. During this period the student works as a junior engineer or physicist on a selected project which forms part of, or is related to, his thesis.	Es-532 Special Systems	3-3
	Es-036 Electronics Admin.	2-0
	Es-832 Thesis Seminar	4-0
	Es-836 Project Seminar	1-0
	Ph-631 Modern Physics	4-0
		14-3

NAVAL ENGINEERING CURRICULUM - N groups

For N groups starting in 1947 only

Objective

The objective of this curriculum is to develop officers competent to direct the inspection, installation and maintenance of naval machinery and equipment (excepting radio and underwater sound equipment) over which the Bureau of Ships has cognizance or for which the engineer officer afloat is held responsible by U. S. Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officers of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory.

(e) Inspectors of naval machinery and material.

Third Year (N3)

Summer Term

EE-792	Power Electronics	3-2
EE-873	Elect. Eng. Design	4-0
ME-212	Power Pt. Equip.	3-4
ME-811	Machine Design	3-2
	Total	13-8

Fall Term

EE-971	Seminar	1-0
ME-215	Power Pt. Analysis	2-4
NE-101	Marine Eng. (Prop.)	3-0
ME-812	Machine Design	3-4
EE-672	Servo-mechanisms	3-4
	Total	12-12

Winter Term

EE-971	Seminar	1-0
Ch-521	Plastics	3-2
ME-216	Mar. Power Pt. Design	2-4
NE-102	Marine Eng. (Aux)	3-0
	Thesis	0-12
	Total	9-18

Spring Term

EE-971	Seminar	1-0
ME-217	Mar. Power Plant (ICE)	4-2
NE-103	Mar. Eng. Dept. Org.	1-0
	Thesis	0-24
	Total	6-26

NAVAL ENGINEERING

Applied Curriculum - NA Groups

Objective

The general objective of this curriculum is to develop officers competent to:

(a) Direct the inspection, installation, operation and maintenance of naval machinery and equipment (excepting radio and sound equipment) over which the Bureau of Ships has cognizance, or for which the Engineering Officer afloat is held responsible by the U. S. Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineering officers of all types of naval vessels and staff engineers afloat.

(b) Maintenance and Repair assignments in the Bureau of Ships, on repair ships, at navy yards, and repair bases.

(c) Inspectors of Naval Machinery and Material.

First Year (NA)

Summer Term

Ma-171 Ord. Diff. Equations	3-0
Ma-201 Graph. & Mech. Comp.	0-2
Mc-101 Plane Dynamics I	3-0
Ch-101 Gen. Chemistry	3-2
EE-151 D.C. Circuits & Fields	3-4
Total	12-9

Fall Term

Ph-610 Atomic Physics	3-0
Ma-172 Diff. Eq. & Infinite Series	3-0
Mc-102 Plane Dynamics II	3-0
Mt-201 Physical Met.	3-2
EE-251 AC Circuits	3-4
Total	15-6

Winter Term

Ma-173 Vector Analysis	3-0
Mt-202 Phys. Met. (Ferrous)	3-2
Ch-521 Plastics	3-2
Ch-111 Fuel & Oil Chem.	2-2
EE-351 DC Machinery	2-2
Total	13-8

Spring Term

Ma-174 Funct. of a complex Va. Part. Diff. Eq., LaPlace Trans.	3-0
ME-700 Mech. of Mach.	3-2
Mt-203 Phy. Metallurgy	2-2
EE-451 Transformers & Synchros.	2-2
ME-111 Thermodynamics	4-2
Total	14-8

Intersessional Field Trip.

Second Year (NA2)

Summer Term		Fall Term	
EE-452 Poly. Trans. Syn. Mach. & Induc. Motors	3-4	ME-830 Mach. Design.	4-2
ME-112a Thermodynamics	3-2	EE-751 Electronics	3-4
ME-511 Str. of Materials	5-0	ME-221a P. P. Equip.	3-2
ME-601 Materials Testing Lab.	0-2	ME-421 Hydro-Equip.	3-2
Mt-301 High Temp. Materials	3-0	*IE-101 Industrial Eng.	0-1
Total	14-8	Total	13-11

Winter Term		Spring Term	
EE-551 Trans. Lines & Filters	3-2	ME-217 Int. Comb. Eng. (Diesel)	4-2
ME-222 P. P. Equip.	3-4	EE-651 Transients & Servos	3-4
NE-101 Marine Eng. (Main Prop)	3-0	ME-224 P. P. Anal.	0-6
*IE-103 Industrial Eng.	0-1	NE-102 Marine Eng. (Aux. Mach.)	3-0
*SL-101 New Weapons	0-1	NE-103 Marine Eng. (Dept. Org.)	1-0
ME-422 Hydro-Equip.	2-2	*IE-104 Human Eng.	0-1
ME-223 P. P. Analysis	2-0	*SL-102 New Weapons	0-1
Total	13-10	Total	11-14

*Lecture course.

NAVAL ENGINEERING

Chemical Curriculum - NC Groups

Objective

The objective of this curriculum is to provide the training necessary for a selected group of officers to:

(a) Supervise and direct activities at the Standards Branch, Bureau of Ships involving Chemical processes.

(b) To act in an advisory capacity with civilian establishments in the development and production of materials for the naval service.

(c) To be able to appreciate developments in industry involving materials other than metals, such as paints, protective coatings, plastics, etc., and advise the Bureau of Ships as to the suitability of such developments in solving probelms of maintainance and repair.

First Year (NC)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-172 Diff. Eq. & Inf. Series	3-0
Ma-201 Graph. & Mech. Comp.	0-2	Ch-221 Qualitative Analysis	3-2
Mc-101 Plane Dynamics I	3-0	Ch-521 Plastics (Eng. Materials)	3-2
Ch-101 General Chemistry	3-2	Mt-201 Physical Metallurgy	3-2
EE-171 Elect. Circ. & Fields	3-4	Ch-611 Thermodynamics (Chem.)	3-2
Total	14-8	Total	15-8

NAVAL ENGINEERING--Chemical Curriculum - NC Groups (Cont'd.)

Winter Term		Spring Term	
Ma-173 Vector Analysis	3-0	Ch-701 Chem. Eng. Calcu-lations	3-2
Mt-202 Phys. Metal. (Ferrous)	3-2	Ch-412 Physical Chemistry	2-2
Ch-411 Physical Chemistry	2-2	Ch-612 Thermodynamics (Chem)	3-2
*SL-101 New Weapons	0-1	Mt-203 Phys. Met.	2-2
Ch-231 Quan. Analysis	3-2	*SL-102 New Weapons	0-1
ME-500 Strength of Materials	3-0	Cr-271 Crystallography & X-ray	3-2
ME-601 Mat. Test. & Str. Anal.	0-2		
Total	14-9	Total	13-11

Second Year (NC2)
at Lehigh University

First Term		Second Term	
Chem. 150 Org. Chem.	3	Chem. 151 Org. Chem.	3
Chem. 165 Org. Chem. Lab.	2	Chem. 167 Org. Chem. Lab.	2
Chem. 190 Phys. Chem.	3	Chem. 194 Phys. & El. Chem.	3
Chem. 192 Phys. Chem. Lab.	1	Chem. 197 El. Chem. Lab.	1
Ch.E. 78 Chem. Engr.	3	Ch.E. 79 Chem. Engr.	3
		Ch.E. 180 Chem. Engr.	3
Credit Hours	12	Credit Hours	15

Interessional Field Trip and Chem. Engr. Res.

Third Year (NC3)
at Lehigh University

First Term		Second Term	
Ch.E. 181 Chem. Engr.	3	Ch.E. 283 Chem. Engr.	3
Ch.E. 282 Chem. Engr.	3	Ch.E. 281 Chem. Engr. Res.	4
Ch.E. 183 Unit Proc.	3	Ch.E. 185 Chem. Engr. Prac.	1
Ch.E. 280 Chem. Engr. Res.	4	Chem. 221 Adv. Phys. Chem.	3
Chem. 220 Adv. Phys. Chem.	3	Ch.E. 286 Ch.E. Proc. Contr.	3
Credit Hours	16	Credit Hours	14

NAVAL ENGINEERING

Mechanical Curriculum - NH Groups

Objective

The object of this Curriculum is to develop officers competent to direct the inspection, installation, and maintenance of Naval Machinery and equipment (excepting radio and underwater sound equipment) over which the Bureau of Ships has cognizance or for which the engineer officer afloat is held responsible by U. S. Naval Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officer of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory.

(e) Inspectors of Naval Machinery and Material.

First Year (NH)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Ma-201 Graph. & Mech. Comp.	0-2	Ph-610 Atomic Physics	3-0
Ch-101 Gen. Chemistry	3-2	Ch-111 Fuel & Oil Chem.	2-2
Mc-101 Plane Dynamics, I	3-0	Mc-102 Plane Dynamics, II	3-0
EE-171 Elect. Cir. & Fields	3-4	EE-251 A.C. Circuits	3-4
Total	14-8	Total	16-6

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var. Vect. Ana.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Ph-210 Geom. & Phys. Optics	3-2	Mt-202 Physical Met. (ferrous)	3-2
Mt-201 Physical Met.	3-2	EE-451 Transformers & Synchros	2-2
Mc-201 Methods of Dynamics	2-2	ME-111 Thermodynamics	4-2
EE-351 DC Machinery	2-2		
Total	15-8	Total	14-6

Intersessional Field Trip.

Second Year (NH2)

Summer Term

fPh-421	Wave Motion & Acoustics	3-0
ffMt-203	Phy. Metallurgy	2-2
ME-112	Thermodynamics	4-2
EE-452	Poly Trans. Sync. Mach. & Induc. Motors	3-4
fffCh-561	Physical Chem.	3-2
	Total	15-10

Fall Term

ME-411	Hydraulic Equip.	4-2
fME-710	Theory of Vibration	3-2
ME-511	Str. of Materials	5-0
Ch-613	Chem. Eng. Thermo.	3-2
*IE-101	Ind. Organization	0-1
	Total	15-9

fSubst. Ph-210 for 1948-51 group.
ffSubst. Mt.201 for 1948-51 group.
fffEliminate for 1948-51 group.

fSubst. Mt-202 for 1948-51 group.

Winter Term

ME-611	Materials Testing Lab.	2-2
EE-751	Electronics	3-4
ME-412	Hydrodynamics	4-2
ME-512	Adv. Str. of Materials	5-0
*IE-103	Ind. Org.	0-1
*SL-101	New Weapons	0-1
	Total	14-10

Spring Term

ME-700	Mech. of Mach.	3-2
ME-211	Mar. PP Equip.	3-2
ME-413	Compressible Fluid Flow	3-0
ME-590	Theory of Elasticity	3-0
ME-310	Heat Transfer	3-2
*IE-104	Human Engineering	0-1
*SL-102	New Weapons	0-1
	Total	15-8

*Lecture Course

Intersessional Field Trips

Third Year (NH3)

Summer Term

ME-212	Mar. Power Plant Equip.	3-4
ME-534	Exp. Stress Analysis	3-2
ME-811	Machine Design	3-2
Mt-301	High Temp. Materials	2-2
	Total	11-10

Fall Term

ME-215	Mar. PP Analysis	2-4
NE-101	Naval Eng. Main Prop.	3-0
ME-812	Adv. Mach. Design	3-4
ME-217	Int. Comb. Eng. (Diesel)	4-2
	Total	12-10

Winter Term

ME-216	Mar. PP Design	2-4
EE-651	Transients & Servos	3-4
	Thesis	9-0
	Total	14-8

Spring Term

NE-102	Nav. Eng. Auxiliaries	3-0
NE-103	Eng. Dep. & Org.	1-0
	Thesis	14-0
	Total	18-0

NAVAL ENGINEERING

Gas Turbine Curriculum - NJ groups

Objective

The objective of the curriculum is by means of practical and theoretical instruction to train a selected group of U. S. Navy officers to be capable of:

(a) Evaluating future trends in the field of Gas Turbine and Jet Propulsion and advising as to the limitations and capabilities of such means as applicable to propulsion requirements of naval vessels.

(b) Directing and supervising research and development in the field of Gas Turbine and Jet Propulsion as may be applicable to propulsion of naval vessels.

(c) Acting in an advisory capacity with civilian establishments in the development and production of such naval machinery as may in the future be operated by the use of Gas Turbines and Jet Propulsion.

First Year (NJ)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Eq.	5-0	Ma-102 Series & Vector Algebra	5-0
Ma-201 Graph. & Mech. Comp.	0-2	Mc-102 Plane Dynamics, II	3-0
Mc-101 Plane Dynamics, I	3-0	ME-141 Chem. Eng'y. Thermo.	4-2
Ch-101 Gen. Chemistry	3-2	Ae-100 Basic Aerodynamics	3-4
EE-171 Elect. Cir. & Fields	3-4		
Total	14-8	Total	15-6

Winter Term		Spring Term	
Ch-111 Fuel & Oil Chemistry	2-2	Ma-104 Part. Diff. Eq. & Rel. Topics.	5-0
Ma-103 Funct. of Sev. Var. & Vector Anal.	5-0	Ch-412 Physical Chemistry	2-2
Ch-411 Physical Chemistry	2-2	Mt-202 Physical Met. (ferrous)	3-2
Mt-201 Physical Metallurgy	3-2	ME-143 Chem. Eng'y. Thermo.	4-4
ME-142 Chem. Eng'y. Thermo	2-2		
Total	14-8	Total	14-8

Interessional Field Trips.

Second Year (NJ2)

Summer Term		Fall Term	
Mt-301 High Temp. Materials	3-0	Ma-106 Complex Var. & Laplace Tr.	4-0
Ma-105 Fourier Series & Boundary Value Problems	4-0	EE-251 A.C. Circuits	3-4
ME-511 Strength of Materials	5-0	Ch-613 Chem. Eng. Thermo	3-2
ME-601 Mat. Testing Lab.	0-2	*IE-101 Ind. Organization	0-1
Ae-501 Theory of Aero.	4-0	Ae-502 Theory of Aero.	4-0
Total	16-2	Total	14-7

NAVAL ENGINEERING--Gas Turbine Curriculum - NJ groups (Cont'd.)
Second Year (NJ2) (Cont'd.)

Winter Term			Spring Term		
Mt-203	Physical Metallurgy	2-2	Ch-541	Reaction Motors	2-2
EE-751	Electronics	3-4	EE-452	Poly Trans. Sync. Mach. & Induc. Motors	3-4
EE-451	Transf. & Synchros	2-2			
Ae-503	Supersonic Aerodynamics	3-2	Ae-431	Gas Turbines & Jets	3-2
Ae-451	Gas Turbine Seminar	3-0	Ae-452	Gas Turbine Seminar	3-0
*IE-103	Ind. Engineering	0-1	*IE-104	Ind. Engineering	0-1
*SL-101	New Weapons	0-1	*SL-102	New Weapons	0-1
	Total	13-12		Total	11-10

*Lecture Course

Interessional Field Trip

Third Year (NJ3)

At Selected University

NAVAL ENGINEERING

Electrical Curriculum - NL Groups

Objective

The objective of this curriculum is to develop officers competent to direct the inspection, installation, and maintenance of naval machinery and equipment (excepting radio and underwater sound equipment) over which the Bureau of Ships has cognizance or for which the engineer officer afloat is held responsible by the U.S. Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officers of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory.

(e) Inspectors of Naval machinery and material.

First Year (NL)

Summer Term

Ma-101	Ord. Diff. Equations	5-0
Ma-201	Graph. & Mech. Comp.	0-2
EE-171	Elect. Cir. & Fields	3-4
Ch-101	General Chemistry	3-2
Mc-101	Plane Dynamics I	3-0
	Total	14-8

Fall Term

Ma-102	Series & Vector Algebra	5-0
EE-271	A.C. Circuits	3-2
Ch-111	Fuel & Oil Chem.	2-2
Mc-102	Plane Dynamics, II	3-0
Ph-610	Atomic Physics	3-0
	Total	16-4

Winter Term

Ma-103	Funct. of Sev. Var. & Vector Anal.	5-0
EE-272	A.C. Circuits	2-2
Mc-201	Methods of Dynamics	2-2
ME-500	Str. of Materials	3-0
ME-601	Str. of Materials (Lab.)	0-2
Mt-201	Physical Met.	3-2
	Total	15-8

Spring Term

Ma-104	Part. Diff. Eq. & Rel. Topics	5-0
EE-371	D.C. Machinery	3-2
ME-111	Thermodynamics	4-2
Mt-202	Physical Met. (Ferrous)	3-2
	Total	15-6

Interessional Field Trip.

Second Year (NL2)

Summer Term

Ma-105	Fourier Ser. & Boundary Value Probs.	4-0
EE-471	Trans. Async. Mach. & Synchros.	3-4
ME-112	Thermodynamics	4-2
ñMt-203	Phy. Metallurgy	2-2
	Total	13-8

Fall Term

Ma-106	Complex Var. & LaPlace	4-0
EE-472	Synchronous Mach.	3-4
EE-971	Seminar	1-0
ME-411	Fluid Mech. (Gen.)	4-2
ME-211	P.P. Equipment	3-2
*IE-101	Ind. Org.	0-1
	Total	15-9

ñSubstitute Mt-101 for 1948-51 group.

Winter Term

Ph-361	Electromagnetism	3-0
EE-571	Trans. Lines & Filters	3-4
EE-971	Seminar	1-0
EE-771	Electronics	3-2
ñMa-301	Statistics	3-2
*IE-103	Ind. Org.	0-1
*SL-101	New Weapons	0-1
	Total	13-10

Spring Term

Ph-362	Electromagnetic Waves	3-0
ME-212a	Mar. P.P. Equip.	3-2
EE-772	Electronics	3-2
EE-971	Seminar	1-0
ME-310	Heat Transmission	3-2
*IE-104	Human Eng.	0-1
*SL-102	New Weapons	0-1
	Total	13 8

ñSubstitute Mt-202 for 1948-51 group.
*Lecture Course.
Interessional Field Trip.

Third Year (NL3)

Summer Term			Fall Term		
Mt-301	High Temp. Materials	3-0	EE-872	Elect. Mach. Design	4-0
EE-871	Elect. Mach. Design	4-0	EE-971	Seminar	1-0
EE-671	Transients	3-4	ME-215	Mar. P.P. Analysis	2-4
ME-217	Internal Comb. Eng. (Diesel)	4-2	EE-672	Servo Mechanisms	3-4
				Thesis	3-0
	Total	14-8		Total	13-8

Winter Term			Spring Term		
EE-873	Elect. Mach. Design	4-0	EE-971	Seminar	1-0
EE-971	Seminar	1-0	NE-102	Mar. Eng. (Aux. Mach.)	3-0
NE-101	Mar. Eng. (Main Prop.)	3-0	NE-103	Mar. Eng. Org.	1-0
	Thesis	9-0		Thesis	12-0
	Total	17-0		Total	17-0

NAVAL ENGINEERING

Metallurgy Curriculum - NM Groups

Objective

The objective of this curriculum is to provide the training necessary for a selected group of officers to be:

(a) Capable of supervising and directing activities at the Standards Branch Bureau of Ships relating to metals and allows.

(b) To advise the Bureau of Ships of developments in metallurgy that may be of value in ship design, maintenance, and operation.

(c) To be capable of directing and supervising research activities involving metals and alloys, and direct activities in Naval Establishments concerned with production, maintenance, and repair.

First Year (NM)

Summer Term			Fall Term		
Ma-101	Ord. Diff. Equations	5-0	Ch-521	Plastics (Eng. Materials)	3-2
Ma-201	Graph. & Mech. Comp.	0-2	Ma-172	Diff. Eq. & Inf. Series	3-0
Mc-101	Plane Dynamics, I	3-0	Ch-22$_1$	Qualitative Analysis	3-2
Ch-101	General Chemistry	3-2	Mt-101	Production Metallurgy	2-0
EE-171	Elect. Circuits & Fields	3-4	Mt-201	Physical Metallurgy	3-2
	Total	14-8		Total	14-6

First Year (NM) - (Cont'd.)

Winter Term		Spring Term	
ME-601 Mat. Test. Lab.	0-2	Mt-203 Phys. Metallurgy (Spec. Topics)	2-2
Ma-173 Vector Analysis	3-0	Ch-531 Phys. Chem. of Metal	2-0
ME-500 Str. of Materials	3-0	Ch-412 Physical Chem.	2-2
Ch-411 Physical Chemistry	2-2	Mt-204 Physical Metal.	3-4
Mt-202 Physical Metallurgy (ferrous)	3-2	Cr-271 Cry. & X-Ray	3-2
*SL-101 New Weapons	0-1	*SL-102 New Weapons	0-1
Ch-231 Quan. Anal.	3-2		
Total	14-9	Total	12-11

*Lecture Course.

Interessional Field trip.

Second Year (NM2)

at Carnegie Institute of Technology

First Term		Second Term	
GE-657a Alloy Steels	2-0-6	GE-657a Alloy Steels	2-0-6
E-631 Fer. Met.	4-0-8	GE-664b Adv. Phys. Met.	2-0-6
GE-664a Av. Phys. Met.	2-0-6	E-652 Mech. Met.	3-0-3
GE-697 Ord. Met.	2-0-6	GE-655b Met. Problems	0-0-2
E-661 Mod. Met. Proc.	0-2-0	E-662 Mod. Met. Practice	0-2-0
GE-663c Radiography	0-2-4	S-292 Stat. Qual. Cont.	3-0-6
S-291 Stat. Qual. Cont.	3-0-6	E-666 Seminar	1-0-0
E-665 Seminar	1-0-0		
Total	54 Units	Total	49 Units

Interessional Field Trip.

Third Year (NM3)

at Carnegie Institute of Technology

First Term		Second Term	
GE-667a Adv. Mech. Met.	2-0-6	GE-667b Adv. Mech. Met.	2-0-6
GE-697 Ord. Met.	2-4-6	E-660 Met. Engrg.	4-0-8
E-661 Mod. Met. Prac.	0-2-0	E-662 Mod. Met. Practice	0-2-0
GE-676a Theory of metals	2-0-6	GE-676b Theory of metals	2-0-6
GE-674a Grad. Seminar	1-0-0	GE-674b Grad. Seminar	1-0-0
E-647 Non-Fer. Metal	3-3-6	GE-633c Crystallography	2-0-4
E-697 Welding Met.	2-0-6	GE-644d Adv. Phys. Met.	2-0-6
Total	50 Units	Total	46 Units

NAVAL ENGINEERING

Petroleum Curriculum - NP Groups

Objective

The objective of this curriculum is, by means of practical and theoretical instruction, to train certain officers of the U. S. Navy in the technology of petroleum production, refining, and utilization of by-products therefrom, in preparation for future duties involving the development, properties, uses and application of fuels and lubricants in the Naval Establishment.

First Year (NP)

Summer Term

Ma-101	Ord. Diff. Equations	5-0
Ma-201	Graph. & Mech. Comp.	0-2
Mc-101	Plane Dynamics, I	3-0
Ch-101	General Chemistry	3-2
EE-171	Elect. Circuits & Fields	3-4
	Total	14-8

Fall Term

Ma-172	Diff. Eq. & Inf. Series	3-0
Ge-101	Phy. Geology	3-0
Ch-211	Qualitative Analysis	3-2
Cr-301	Cry. & Mineralogy	3-4
Mt-201	Physical Metallurgy	3-2
	Total	15-8

Winter Term

Ma-173	Vector Analysis	3-0
Ch-111	Fuel & Oil Chem.	2-2
Ch-231	Quanlitative Analysis	2-4
GE-302	Determin. Mineralogy	1-4
ME-601	Mat. Test. Lab.	0-2
ME-500	Str. of Materials	3-0
*SL-101	New Weapons	0-1
	Total	11-13

Spring Term

Ch-301	Org. Chemistry	3-2
Ch-421	Physical Chemistry	4-2
Mt-202	Phy. Meta. (Ferrous)	3-2
Ge-241	Petroleum geology	2-2
Ge-401	Petrology & Petrography	2-2
*SL-102	New Weapons	0-1
	Total	14-11

*Lecture Course

Intersessional Field Trip.

Second Year (NP2)

at University of California at Berkeley

First Term

Chem. 8	Org. Chemistry	3
Chem. 9	Org. Chem. (Lab.)	3
M.E.-103	Fluid Mechanics	3
P.E.-121A	Oil-Field Develop.	3
P.E.-129	Prod. & Util. of Nat. Gas	2
	Total Units	14

Second Term

P.E.-121-B	Oil Field Explot.	3
P.E.-125	Pet. Eng. Economics	3
P.E.-299	Thesis Research	2
Chem. 298A	Seminar on Behavior of hydrocarbons	2
Math 264	Quality Control	3
	Total Units	13

Interessional Field Trip.

Third Year (NP3)

at University of California at Berkeley

First Term

Chem. 109 Phy. Chemistry	3
P.E. 209A Pet. Refining Tech.	2
M.E. 120 Eng. Invest. & Econ.	3
Phy. 121 Radioactivity & Nuclear Structure	3
P.E. 299 Thesis Research	2
Total Units	13

Second Term

Chem. 143 Chem. Technology	3
P.E.-209B Pet. Refining Tech.	2
M.E. 118 Indust. Power Plant Design	3
P.E. 299 Thesis Research	4
Total Units	12

ORDNANCE ENGINEERING CURRICULA

The objective of all Ordnance Engineering Curricula is to prepare officers for shore duty assignments under the cognizance of the Bureau of Ordnance. This duty includes technical and technical administrative billets within the Bureau of Ordnance and in its field activities, which include the Naval Ordnance Test Stations, the Naval Proving Ground, the Naval Ordnance Laboratory, the Naval Ammunition Depots and Magazines, the Naval Gun Factory, the Naval Ordnance Plants and the Naval Powder Factory. While the curricula are definitely pointed toward shore duty assignments in Ordnance Activities, the knowledge acquired will be of exceedingly great value in gunnery billets afloat.

ORDNANCE ENGINEERING

General Ordnance Curriculum - O Groups

Objective

The obejctive of the Ordnance Engineering (General) curriculum is to prepare officers for future duties as inspectors of ordnance material, to equip them to deal with problems of development and production in Bureau of Ordnance establishments, and to give them the basic technical education to become expert operators of ordnance equipment afloat.

First Year (O)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	EE-251 A.C. Circuits	3-4
EE-151 DC Circuits & Fields	3-4	Mc-102 Plane Dynamics II	3-0
Ch-101 Gen. Inorganic Chem.	3-2	Ch-521 Plastics	3-2
Or-205 Surface Fire Control	2-0	Ord304 A.A. Fire Control	1-2
Total	16-6	Total	15-8

Winter Term		Spring Term	
Ma-103 Func. of Several Var. & Vector Analysis	5-0	Ma-104 Partial Diff. Eq. & Related Topics	5-0
Ma-251 Grph. & Mech. Comp.	0-4	ME-700 Mech. of Machinery	3-2
Mc-103 Space Dynamics I	2-0	EE-452 Polyphase Trans., etc.	3-4
EE-451 Transf. & Synchros	2-2	Or-501 Underwater Ordnance	2-0
ME-509 Strength of Materials	5-0	Or-103 Ord. Admin. & Spec. Eqp.	2-0
Or-305 A.A. Fire Control	2-0	SL-102 New Weapon Dev. Lect.	---
SL-101 New Weapon Dev. Lect.	---	Total	15-6
Total	16-6		

Interessional Field Trip.

SECOND YEAR (02)

At Postgraduate School

Summer Term		Fall Term	
Ma-155 Selected Adv. Topics	3-0	Mc-421 Interior Ballistics	2-0
EE-551 Trans. Lines & Filters	3-2	Ma-106 Complex Var. & LaPlace Trans.	4-0
Ph-250 Optics	3-2		
EE-751 Electronics	3-4	Es-446 Intro. To Radar	2-2
Or-404 Guided Missile Guidance	2-0	Ma-351 Statistics I	2-2
Or-503 Mine Design	2-0	Mc-401 Exterior Ballistics	3-0
		Ph-450 Acoustics (underwater)	3-1
Total	16-8	Or-405 Guided Missile Guidance	1-0
		IE-101 Indus. Management Lect.	---
		Total	17-5

Winter Term		Spring Term	
Ma-352 Statistics II	1-2	Mc-431 Strength of Guns	3-0
Mc-402 Dyn. of a Rigid Body	3-0	EE-672 Servo-Mechanisms	3-4
EE-671 Transients	3-4	Mt-202 Ferrous Phys. Metallurgy	3-2
Ch-631 Thermodynamics	3-2	Ch-541 Reaction Motors	2-2
Mt-201 Intro. Physical Metal	3-2	ME-840 Manufacturing Eng.	3-2
IE-103 Indus. Management Lect.	---	IE-104 Indus. Management Lect.	---
SL-101 New Weapon Dev. Lect.	---	SL-102 New Weapon Dev. Lect.	---
Total	13-10	Total	14-10

Interessional Field Trip.

THIRD YEAR (03)

At Purdue University

Fall Term		Spring Term	
GE-128 Motion & Time Study	3	GE-185 Production Control	3
GE-183 Production Planning	3	GE-186 Plant Layout	3
GE-184 Tool design	3	GE-299 Thesis	9
GE-107 Industrial Personnel Relations	3	Psych-175 Psychology of Industrial Training	3
GE-91 Elementary Accounting	3		
Psych-173 Personnel Psychology	3	Total	18
Total	18		

ORDNANCE ENGINEERING

Fire Control Curriculum - OC Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OC)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	Mc-102 Plane Dynamics II	3-0
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Circuits	3-4
Ch-101 Gen. Inorganic Chem.	3-2	Ma-106 Complex Var. & Laplace Transform	4-0
Or-205 Surface Fire Control	2-0	Or-304 A.A. Fire Control	1-2
Total	16-6	Total	16-6

Winter Term		Spring Term	
Ma-103 Func. of Several Var. & Vector Anal.	5-0	Ma-104 Partial Diff. Eq. & Related Topics	5-0
Mc-103 Space Dynamics I	2-0	EE-455 Trans, Async. Mach. & Synchros	2-2
EE-451 Transformers & Synchros	2-2	Es-262 Electron Tubes & Cir.	3-2
Es-261 Electron Tubes & Cir.	3-2	Ma-451 Math. Comp. by Mech. Means	3-2
Or-305 A.A. Fire Control	2-0	Mc-201 Methods in Dynamics	2-2
EE-551 Trans. Lines & Filters	3-2	SL-102 New Weapon Dev. Lect.	---
SL-101 New Weapon Dev. Lect.	---		
Total	17-6	Total	15-8

INTERESSIONAL FIELD TRIP

Second Year (OC2)

At M.I.T.

Fall Term		Spring Term	
6.20 Elect. Cont. & Meas.	3-0-6	6.602 Machine Computation	3-4-6
6.581 Trans. in Linear Sys.	3-0-6	6.605 Servomechanisms	3-0-6
6.756 Elec. Meas. Lab.	0-4-4	6.623 Pulse Circuits, Prin.	3-0-6
16.41 Intr. to F.C. Instr.	3-0-6	16.42 F.C. Inst. Adv.	4-0-8
16.43 F.C. Inst. Lab.	0-3-5	16.46 F.C. Inst. Lab., Adv.	0-3-5
Total	43	Total	51

Interessional Field Trip.

Third Year (OC3)

At M.I.T.

Fall Term			Spring Term		
6.607	Servomechanisms Lab.	0-12-0	6.681	Spec. Prob. in F. C.	6-0-12
6.608	Servomechanisms	3-0-6		Thesis	0-30-0
16.45	F.C. Inst., Adv.	4-0-8			
L17	Scientific German	3-0-6		Total	48
	Thesis	0-7-0			
	Total	49			

ORDNANCE ENGINEERING

Aviation Ordnance Curriculum OE Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year

Summer Term			Fall Term		
Ma-101	Ord. Diff. Equations	5-0	Ma-102	Series & Vector Algebra	5-0
Mc-101	Plane Dynamics I	5-0	EE-251	A.C. Circuits	3-4
EE-151	D.C. Circuits & Fields	3-4	Mc-102	Plane Dynamics II	3-0
Ch -101	Gen. Inorganic Chem.	3-2	ME-500	Strength of Materials	3-0
			Ae-100	Basic Aerodynamics	3-4
	Total	16-6	Ae-001	Aeronautical Lecture	---
				Total	17-8

Winter Term			Spring Term		
Ma-103	Func. of Several Var. & Vector Anal.	5-0	Ma-104	Partial Diff. Eq. & Related Topics	5-0
EE-451	Transformers & Synchros	2-2	EE-455	Syne. Mach. & Indac Ma.	2-2
Mt-201	Intro. Physical Metal	3-2	Mt-202	Physical Metallurgy (Ferrous)	3-2
Ae-121	Technical Aerodynamics	3-2	Ae-136	Aircraft Perf. Flight Anal.	3-2
SL-101	New Weapon Dev. Lect.	---	SL-102	New Weapon Dev. Lect.	---
Ae-201	Stress & Analy.	4-2	Ae-202	Stress Analy. II	4-2
	Total	17-8		Total	17-8

Interessional Field Trip.

Second Year (OE2)

At Naval Postgraduate School

Summer Term

Ma-155	Selected Adv. Topics	3-0
Ae-501	Hydro-aero-mechanics	4-0
EE-551	Trans. Line & Filters	3-2
EE-751	Electronics	3-4
Ph-250	Optics	3-2
	Total	16-8

Fall Term

Mc-401	Experior Ballistics	3-0
Ae-502	Hydro-aero-mechanics	4-0
Ma-401	Math. Comp. by Mech. Means	2-2
Ma-106	Compl. Var. & LaPlace Tr.	4-0
IE-101	Prins. of Indus. Org.	---
AE-001	Aeronautical Lect.	---
EE-755	Electronic Cont. & Meas.	3-4
	Total	16-6

Winter Term

EE-671	Transients	3-4
Mc-402	Dynamics of a Rigid Body	3-0
Ae-146	Dynamics	3-2
Or-404	Guided Missile Guidance	2-0
SL-101	New Weapons Dev. Lect.	---
IE-103	Applied Indus. Org.	---
Ae-503	Compressibility	4-0
	Total	15-6

Spring Term

EE-753	Electronics	1-2
EE-672	Servomechanisms	3-4
Mc-201	Methods in Dynamics	2-2
Es-456	Intro. to Radar	2-2
Mt-203	Physical Metallurgy	2-2
Or-405	Guided Missile Guidance	1-0
SL-102	New Weapons Dev. Lect.	---
IE-104	Psychophysical Sys. Res.	---
	Total	11-12

Interessional Field Trip.

Third Year (OE3)

At M.I.T.

Fall Term

16.15	Stab. & Cont. of Aircraft Adv.	3-0-6
16.39	Auto. Contr. Equip. for Aircraft	3-0-6
16.40	Space Kin. & Gyr. Inst. Th.	3-0-6
16.41	Intro. to F.C. Instr.	3-0-6
16.43	F.C. Instr. Lab.	0-3-5
	Thesis	0-6-0
	Total	50

Spring Term

16.44	F.C. Instr. Adv.	4-0-8
16.46	F.C. Inst. Lab. Adv.	0-3-5
	Thesis	0-30-0
	Total	50

ORDNANCE ENGINEERING

Guided Missile Guidance Ordnance Curriculum - OG Groups.

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OG)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	Mc-102 Plane Dynamics II	3-0
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Circuits	3-4
Ch-101 Gen. Inorganic Chem.	3-2	Ae-100 Basic Aerodynamics	3-4
Or-205 Surface Fire Control	2-0	Or-304 A.A. Fire Control	1-2
Total	16-6	Total	15-10

Winter Term		Spring Term	
Ma-103 Func. of Several Var. & Vector Anal.	5-0	Ma-104 Partial Diff. Eq. & Related Topics	5-0
Mc-103 Space Dynamics I	2-0	Ma-451 Math. Comp. by Mech. Means	3-2
EE-451 Transformers & Synchros	2-2	EE-455 Syne Mach. & Ind. Mo.	2-2
Or-305 A.A. Fire Control	2-0	Or-103 Ord. Admin. & Spec. Equip.	2-0
SL-101 New Weapons Dev. Lect.	---	SL-102 New Weapons Dev. Lect.	---
Or-404 Guided Missile Guidance	2-0	Or-405 Guided Missile Guidance	1-0
Ae-121 Tech. Aerodynamics	3-2	Ae-136 Aircraft Perf.-Flight Analysis	3-2
Total	16-4	Total	16-6

Interessional Field Trip.

Second Year (OG2)

At Naval Postgraduate School

Summer Term		Fall Term	
Ma-155 Selected Adv. Topics	3-0	Mc-401 Exterior Ballistics	3-0
EE-551 Trans. Lines & Filters	3-2	Ma-106 Compl. Va. & LaPlace Tr.	4-0
EE-751 Electronics	3-4	ME-132 Eng. Thermodynamics	3-2
ME-131 Engrg. Thermodynamics	3-2	EE-755 Electronic Cont. & Meas.	3-4
Ae-501 Hydro-aero-mechanics	4-0	Ae-502 Hydro-aero-mechanics	4-0
		IE-101 Prins. of Indus. Org.	---
Total	16-8	Total	17-6

Second Year (OG2) - At Naval Postgraduate School (Cont'd.)

Winter Term		Spring Term	
Mc-402 Dyn. of a Rigid Body	3-0	EE-753 Eleccronics	1-2
EE-671 Transients	3-4	EE-672 Servomechanisms	3-4
Ae-503 Compressibility	3-2	Mc-201 Methods in Dynamics	2-2
Ch-631 Thermodynamics	3-2	Es-456 Intro. to Radar	2-2
SL-101 New Weapons Dev. Lect.	---	Ch-541 Reaction Motors	2-2
IE-103 Applied Indus. Org.	---	SL-102 New Weapons Dev. Lab.	---
		IE-104 Psychophysical Sys. Res.	---
Total	12-8	Total	10-12

Interessional Field Trip.
J.H.U. Applied Physics Lect.

Third Year (OG3)

At Johns Hopkins University

Curriculum under revision.

ORDNANCE ENGINEERING

Jet Propulsion Ordnance Curriculum - OJ Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OJ)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	Ae-100 Basic Aerodynamics	3-4
EE-151 D.C. Circuits & Fields	3-4	Or-304 A.A. Fire Control	1-2
Ch-101 Gen. Inorganic Chem.	3-2	EE-251 A.C. Circuits	3-4
Or-205 Surface Fire Control	2-0		
Total	16-6	Total	12-10

Winter Term		Spring Term	
Ma-103 Func. of Several Var. & Vector Anal.	5-0	Ma-104 Partial Diff. Eq. & Related Topics	5-0
EE-451 Transformers & Synchros	2-2	EE-455 Sync. Mach. & Induc. Mo.	2-2
Mt-201 Intro. Physical Metallurgy	3-2	Ph-540 Kinetic Theory & Stat. Mech.	3-0
Ch-411 Physical Chemistry	2-2	Mt-202 Ferrous Phys. Metal.	3-2
Or-305 A.A. Fire Control	2-0	Ch-412 Physical Chemistry	2-2
SL-101 New Weapons Dev. Lect.	---	Or-103 Ord. Admin. & Spec. Eqp.	2-0
Total	14-6	SL-102 New Weapons Dev. Lect.	---
		Total	17-6

Interessional Field Trip.

Second Year (OJ2)

At Naval Postgraduate School.

Summer Term		Fall Term	
EE-751 Electronics	3-4	Ma-106 Compl. Var. & LaPlace Tr.	4-0
Mt-301 High Temp. Materials	2-2	Me-141 Chem. Eng. Thermo.	4-2
Ph-250 Optics	3-2	EE-755 Electronic Control & Meas.	3-4
AE-501 Hydro-aero-mechanics	4-0	Ae-502 Hydro-aero-mechanics	4-0
Or-404 Guided Missile Guidance	2-0	Or-405 Guided Missile Guidance	1-0
		IE-101 Prins. of Indus. Org.	---
Total	14-8	Total	16-6

Winter Term		Spring Term	
Ae-503 Compressibility	3-2	Ae-431 Internal Flow in Aircraft Engines	2-2
ME-142 Chem. Eng. Thermo.	2-2	Ch-541 Reaction Motors	2-2
ME-509 Strength of Materials	5-0	EE-672 Servomechanisms	3-4
EE-671 Transients	3-4	ME-143 Chem. Eng. Thermo.	4-4
IE-103 Applied Indus. Org.	---	IE-104 Psychophysical Sys. Res.	---
SL-101 New Weapons Dev. Lect.	---	SL-102 New Weapons Dev. Lect.	---
Total	13-8	Total	11-12

Interessional Field Trip.

Third Year (OJ3)

At Cal. Inst. of Tech. and Rens. Poly. Inst.

Curriculum under revision.

ORDNANCE ENGINEERING

Metallurgical Ordnance Curriculum - OM Groups.

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OM)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	Ch-221 Qualitative Analysis	3-2
Ch-101 Gen. Inorganic Chem.	3-2	EE-251 A.C. Circuits	3-4
EE-151 DC Circuits & Fields	3-4	Mt-101 Production Metallurgy	2-0
Or-205 Surface Fire Control	2-0	Mt-201 Intro. Phys. Metal.	3-2
Total	16-6	Total	16-8

First Year (OM) (Cont'd.)

Winter Term			Spring Term		
Ma-103	Func. of Several Var & Vector Anal.	5-0	Ma-104	Par. Diff. Eq. & Related Topics	5-0
Ch-231	Quantitative Analysis	2-4	Ch-412	Physical Chemistry	2-2
Ch-411	Physical Chemistry	2-2	Ch-531	Physical Chem.	2-0
EE-451	Transformers & Synchros	2-2	Cr-271	Crystal. & X-Ray Tech.	3-2
Mt-202	Ferrous Phys. Metal.	3-2	Mt-204	Physical Metallurgy	3-4
SL-101	New Weapons Dev. Lect.	---	SL-102	New Weapons Dev. Lect.	---
	Total	14-10		Total	15-8

Interessional Field Trip.

Second Year (OM2)

At Naval Postgraduate School.

Summer Term			Fall Term		
EE-751	Electronics	3-4	ME-511	Strength of Materials	5-0
Mt-206	Physics of Metals	3-2	EE-755	Electronic Con. & Meas.	3-4
Or-503	Mine Design	2-0	Mc-421	Interior Ballistics	2-0
Ph-250	Optics	3-2	Mt-103	Prod. of Non-Ferrous Met.	3-0
Mt-301	High Tem. Materials	2-2	Or-304	A.A. Fire Control	1-2
	Total	13-10	IE-101	Prins. of Indus. Org.	---
			Mt-102	Prod. of Steel	3-0
				Total	17-6

Winter Term			Spring Term		
ME-512	Strength of Materials Adv.	5-0	Ma-301	Statistics	3-2
Mt-205	Adv. Phys. Metallurgy	3-4	Mc-431	Strength of Guns	3-0
Mt-302	Alloy Steels	4-2	ME-632	Exptl. Stress. Anal.	2-2
Or-305	A.A. Fire Control	2-0	Mt-203	Physical Metallurg	2-2
Ph-610	Atomic Physics	3-0	Mt-303	Metals Seminar	2-0
IE-103	Applied Indus. Org.	---	Or-103	Ord. Admin. & Spec. Eqp.	2-0
SL-101	New Weapons Dev. Lect.	---	Or-501	Underwater Ordnance	2-0
	Total	17-6	IE-104	Psychophysical Sys. Res.	---
			SL-102	New Weapons Dev. Lect.	---
				Total	16-6

Interessional Field Trip.

Third Year (OM3)

At Carnegie Institute of Technology.

Curriculum under revision.

ORDNANCE ENGINEERING

Chemical Ordnance Curriculum - OP Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OP)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	EE-251 A.C. Circuits	3-4
EE-151 D.C. Circuits & Fields	3-4	Ch-221 Qualitative Analysis	3-2
Ch-101 Gen. Inorganic Chem.	3-2	Ch-311 Organic Chemistry	3-2
Ord. 205 Surface Fire Control	2-0		
Total	16-6	Total	14-8

Winter Term		Spring Term	
Ma-103 Func. of Several Var. & Vector Anal.	5-0	Ma-104 Part. Diff. Eq. & Related Topics	5-0
EE-451 Transformers & Synchros	2-2	Ph-540 Kinetic Theory &. Stat. Mech.	3-0
Ch-231 Quantitative Analysis	2-4	Ch-412 Physical Chemistry	2-2
Ch-312 Organic Chemistry	3-2	Ch-701 Chem. Eng. Calc.	3-2
Ch-411 Physical Chemistry	2-2	Cr-271 Crystal. & X-Ray Tech.	3-2
SL-101 New Weapons Dev. Lect.	---	Or-501 Underwater Ordnance	2-0
Total	14-10	SL-102 New Weapons Dev. Lect.	---
		Total	18-6

Interessional Field Trip.

Second Year (OP2)

At Naval Postgraduate School.

Summer Term		Fall Term	
Ch-321 Organic Qualitative Analysis	2-2	Ch-322 Adv. Organic Chem.	3-2
Ch-413 Physical Chemistry	2-2	EE-755 Electronic Con. & Meas.	3-4
EE-751 Electronics	3-4	ME-141 Chem. Eng. Thermo.	4-2
Or-404 Guided Missile Guidance	2-0	Mc-421 Interior Ballistics	2-0
Or-503 Mine Design	2-0	Or-304 A.A. Fire Control	1-2
Ph-250 Optics	3-2	Or-405 Guided Missile Guidance	1-0
		IE-101 Prins. of Indus. Org.	---
Total	14-10	Total	14-10

Second Year (OP2) - At Naval Postgraduate School. - (Cont'd.)

Winter Term		Spring Term	
Ch-521 Plastics	3-2	Ch-541 Reaction Motors	2-2
Ch-323 Chem. High Polymers	3-0	Ch-800 Chemistry Seminar	2-0
ME-142 Chem. Eng. Thermo.	2-2	ME-143 Chemical Eng. Thermo	4-4
Mt-201 Intro. Phys. Metallurgy	3-2	Mt-202 Ferrour Phys. Metal.	3-2
Or-305 A.A. Fire Control	2-0	Or-103 Ord. Admin. & Spec. Eqp.	2-0
Ph-610 Atomic Physics	3-0	Mc-431 Strength of Guns	3-0
IE-103 Applied Indus. Org.	---	IE-104 Psychophysical Sys. Res.	---
SL-101 New Weapons Dev. Lect.	---	SL-102 New Weapons Dev. Lect.	---
Total	16-6	Total	16-8

Interessional Field Trip.

Third Year (OP3)

At Lehigh University.

First Semester		Second Semester	
Chem.220 Adv. Phys. Chem.	3	Chem.221 Adv. Phys. Chem.	3
Chem.157 Qual. Organic Anal.	3	Chem.158 Adv. Organic Chem.	3
Chem.202 Adv. Inorganic Chem.	3	Chem.232 Adv. Analytical Chem.	3
Chem.2-- --- Chem. Research	3	Chem.2-- --- Chem. Research	3
Ph.160 Intro. to modern Phys. Theories	3	Ph.161 Intro. to modern Phys. Theories	3
Total	15	Total	15

ORDNANCE ENGINEERING

Physics Electronics Ordnance Curriculum - OR Groups.

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OR)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	Mc-102 Plane Dynamics II	3-0
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Circuits	3-4
Ch-101 Gen. Inorganic Chem.	3-2	Ae-100 Basic Aerodynamics	3-4
Or-205 Surface Fire Control	2-0		
Total	16-6	Total	14-8

Physics Electronics Ordnance Curriculum - First Year (OR) - (Cont'd.)

Winter Term		Spring Term	
Ma-103 Func. of Several Var. & Vector Anal.	5-0	Ma-104 Partial Diff. Eq. & Related Topics	5-0
EE-451 Transformers & Synchros	2-2	Es-226a Pulse Circuits	2-1
Es-113 Circuit Anal. & Meas.	3-3	Es-114 Circuit Anal. & Meas.	3-3
Es-261 Electron Tubes & Cir.	3-2	Es-262 Electron Tubes & Cir.	3-2
Mc-103 Space Dynamics I	2-0	EE-455 Sym. Mach. & Induc. Mo.	2-2
SL-101 New Weapons Dev. Lect.	---	SL-102 New Weapons Dev. Lect.	---
Total	15-7	Total	15-8

Interessional Field Trip

Second Year (OR2)

At Naval Postgraduate School.

Summer Term		Fall Term	
Ae-501 Hydro-aero-mechanics	4-0	Ae-502 Hydro-aero-mechanics	4-0
Es-621 Electromagnetics	3-0	EE-755 Electronic Con. & Meas.	3-4
Es-431 Radar	3-3	Es-622 Electromagnetics	4-0
Or-503 Mine Design	2-0	Or-304 A.A. Fire Control	1-2
Ph-250 Optics	3-2	Ph-450 Acoustics (underwater)	3-1
		IE-101 Prins. of Indus. Org.	---
Total	15-5	Total	15-7

Winter Term		Spring Term	
Ae-503 Compressibility	3-2	Ch-541 Reaction Motors	2-2
Ch-631 Thermodynamics	3-2	EE-672 Servomechanisms	3-4
Es-121 Adv. Circuit Theory	3-2	Es-122 Adv. Circuit Theory	3-2
Es-623 Electromagnetics	4-0	Es-624 Electromagnetics	3-0
Or-305 A.A. Fire Control	2-0	Or-103 Or. Admin. & Spec. Eqp.	2-0
Or-404 Guided Missile Guidance	2-0	Or-405 Guided Missile Guidance	1-0
IE-103 Applied Indus. Org.	---	IE-104 Psychophysical Sys. Res.	---
SL-101 New Weapons Dev. Lect.	---	SL-102 New Weapons Dev. Lect.	---
Total	17-6	Total	14-8

Interessional Field Trip.

Third Year (OR3)

At M.I.T.

Fall Term		Spring Term	
6.621 Microwave Circuits	3-0-6	6.502 Electrical Eng. Seminar	2-0-2
6.633 Electronic-Circ. Theory	3-0-6	6.562 Network Theory. Adv.	3-0-6
6.501 Electrical Eng. Seminar	2-0-10	6.622 Antennas	3-0-6
6.561 Network Theory, Adv.	3-0-6	Thesis	30
L17 Scientific German	3-0-6		
Thesis	5	Total	52
Total	53		

ORDNANCE ENGINEERING

Mechanical Electrical Propulsion Ordnance

Curriculum - OT Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OT)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	Mc-152 Plane Dynamics II	3-0
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Circuits	3-4
Ch-101 Gen. Inorganic Chem.	3-2	Ae-100 Basic Aerodynamics	3-4
Or-205 Surface Fire Control	1-0		
Total	16-6	Total	14-8

Winter Term		Spring Term	
EE-451 Transformers & Synchros	2-2	EE-455 Sync. Mach. & Induc. Mo.	2-2
Ma-103 Func. of Several Var. & Vector Anal.	5-0	Ma-104 Partial Diff. Eq. & Related Topics	5-0
Mc-103 Space Dynamics I	2-0	Mc-201 Methods in Dynamics	2-2
Mt-201 Intro. Physical Metal.	3-2	Mt-202 Ferrous Phys. Metal.	3-2
ME-509 Strength of Materials	5-0	Or-501 Underwater Ordnance	2-0
SL-101 New Weapons Dev. Lect.	---	SL-102 New Weapons Dev. Lect.	---
Total	17-4	Total	14-6

Interessional Field Trip.

Second Year (OT2)

At Naval Postgraduate School

Summer Term		Fall Term	
Mt-301 High Temp. Materials	2-2	Ma-106 Compl. Var. & LaPlace Tr.	4-0
EE-551 Trans. Lines & Filters	3-2	EE-755 Electronics	3-4
EE-751 Electronics	3-4	ME-141 Chemical Eng. Thermo.	4-2
Ae-501 Hydro-aero-mechanics	4-0	Ae-502 Hydro-aero-mechanics	4-0
Or-503 Mine Design	2-0	IE-101 Prins. of Indus. Org.	---
Total	14-8	Total	15-6

Second Year (OT2) - At Naval Postgraduate School - (Cont'd.)

Winter Term		Spring Term	
EE-671 Transients	3-4	EE-672 Servomechanisms	3-4
Ch-581 Special Fuels	2-2	Ch-541 Reaction Motors	2-2
ME-142 Chem. Eng. Thermo.	2-2	ME-143 Chem. Eng. Thermo.	4-4
Mt-203 Physical Metallurgy	2-2	ME-310 Heat Transmission	3-2
Ae-503 Compressibility	3-2	IE-104 Psychophysical Sys. Res.	---
IE-103 Applied Indus. Org.	---	SL-102 New Weapons Dev. Lect.	---
SL-101 New Weapons Dev. Lect.	---		
Total	12-12	Total	12-12

Interessional Field Trip.

Third Year (OT3)

At M.I.T.

Fall Term		Spring Term	
16.40 Space Kin. & Gyr. Inst. Th.	3-0-6	16.42 F.C. Inst., Adv.	4-0-8
16.41 Intro. to F.C. Instr.	3-0-6	2.287 Rotating Fluid Machy.	3-0-9
16.43 F.C. Instr. Lab.	0-3-5	Thesis	26
2.213 Gas Turbines	3-0-9		
Thesis	10	Total	50
Total	48		

ORDNANCE ENGINEERING

Subsurface Physics Electronics Ordnance

Curriculum - OW Groups.

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OW)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equation	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	Ph-141 Analytical Mechanics	4-0
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Circuits	3-4
Ch-101 Gen. Inorganic Chem.	3-2	Ae-100 Basic Aerodynamics	3-4
Or-205 Surface Fire Control	2-0		
Total	16-6	Total	15-8

First Year (OW) - Subsurface Physics Electronics Ordnance - (Contd.)

Winter Term		Spring Term	
EE-451 Transformers & Synchros	2-2	EE-455 Syncs. Mach. & Indus. Motors	2-2
Es-261 Electron Tubes & Cir.	3-2	Es-262 Electron Tubes & Cir.	3-2
Ma-103 Func. of Several Var. & Vector Anal.	5-0	Ma-104 Partial Diff. Eq. & Related Topics	5-0
SL-101 New Weapons Dev. Lect.	---	Or-501 Underwater Ordnance	2-0
Ph-142 Analytical Mechanics	4-0	Ph-540 Kinetic Theory & Stat. Mech.	3-0
		SL-102 New Weapons Dev. Lect.	---
		OR-103 Ord. Admin. & Spec. Eqp.	2-0
Total	14-4	Total	17-4

Interessional field trip.

Second Year (OW2)

At Naval Postgraduate School.

Summer Term		Fall Term	
Ph-250 Optics	3-2	Ae-502 Hydro-aero-mechanics	4-0
Ae-501 Hydro-aero-mechanics	4-0	Ma-106 Compl. Var. & LaPlace Tr.	4-0
EE-551 Trans. Lines & Filters	3-2	Me-141 Chem. Eng. Thermo.	4-2
Or-503 Mine Design	2-0	EE-755 Electronic Con. & Meas.	3-4
Ph-421 Fundamental Acoustics	3-0	Ph-422 Applied Acoustics	3-0
		IE-101 Prins. of Indus. Org.	---
Total	15-4	Total	18-6

Winter Term		Spring Term	
EE-671 Transients	3-4	EE-672 Servomechanisms	3-4
Me-142 Chem. Eng. Thermo.	2-2	EE-753 Electronics	1-2
Ph-423 Underwater Acoustics	2-3	ME-143 Chem. Eng. Thermo.	4-4
Ph-610 Atomic Physics	3-0	Ph-424 Sonar Systems	2-4
IE-103 Applied Indus. Org.	---	IE-104 Psychophysical Sys. Res.	---
SL-101 New Weapons Dev. Lect.	---	SL-102 New Weapons Dev. Lect.	---
Total	10-9	Total	10-14

Interessional field trip.

Third Year (OW3)

At U.C.L.A.

Curriculum under revision.

ORDNANCE ENGINEERING

Special Physics Ordnance Curriculum - OX Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OX)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-101 Plane Dynamics I	3-0	EE-251 A.C. Circuits	3-4
EE-151 D.C. Circuits & Fields	3-4	Ph-141 Analytical Mechanics	4-0
Ch-101 Gen. Inorganic Chem.	3-2	Ma-106 Compl. Var. & LaPlace Tr.	4-0
Or-205 Surface Fire Control	2-0	Or-304 A.A. Fire Control	1-2
Total	16-6	Total	17-6

Winter Term		Spring Term	
Ma-103 Func. of Several Var. & Vector Analysis	5-0	Ma-104 Partial Diff. Eq. & Related Topics	5-0
EE-451 Transformers & Synchros	2-2	EE-651 Servomechanisms & Transients	3-4
Es-113 Circuit Anal. & Meas.	3-3	Es-114 Circuit Anal. & Meas.	3-3
Es-261 Electron Tubes & Cir.	3-2	Es-262 Electron Tubes & Cir.	3-2
SL-101 New Weapons Dev. Lect.	---	SL-102 New Weapons Dev. Lect.	---
Ph-142 Analytical Mechanics	4-0		
Total	17-7	Total	14-9

Second Year (OX2)

At M.I.T.

Summer Term

First Half		Second Half	
8.07 Thermo and Statist. Mech.	8-0-10	8.06N Nuclear Physics	8-0-12
8.05N Atomic Physics	8-0-12	8.08 Electronics	8-0-10
Total	38	Total	38

Fall Term		Spring Term	
6.20 Elect. Cont. and Meas.	3-0-6	8.101 Experimental Physics II	0-6-6
8.71 Int. to Theo. Physics	4-0-8	8.72 Int. to Theo. Physics II	4-0-8
6.633 Electronic-Circuit Theory	A 3-0-6	6.623 Pulse Circuits, Prin.	A3-0-6
6.80 Elec. Meas. Lab.	0-5-5	6.624 Electrodyn. of Particles	A3-0-6
L17 Scientific German	3-0-6		
Total	49	Total	42

Interessional field trip.

Third Year (OX3)

At M.I.T.

Fall Term		Spring Term	
8.231 Elec. Discharges in Gases	A 3-0-6	8.512 Nuclear Physics II	A 3-0-6
8.511 Nuclear Physics I	A 3-0-6	8.513 Nuclear Physics Lab.	A 0-3-3
8.57 Int. to Nuclear Engineering	A 3-0-6	Thesis	A 30
8.68T Spec. Prob. in Nuclear Physics	A 15	Total	45
Total	42		

RADIOLOGICAL DEFENSE ENGINEERING

Radiological Defense Engineering Curriculum - RZ Groups.

Objective

The objective of this curriculum is to train officers of the Armed services in the fundamental sciences especially in those pertaining to nuclear and medical physics and associated with the problems that arise from the applications of atomic energy.

First Year (RZ)

Summer Term		Fall Term	
Ma-181 Partial Deriv. & Ord. Diff. Eqs.	5-0	Ma-182 Vector Anal.	5-0
Ph-240 Optics & Optical Spectra	3-3	Ph-141 Analytical Mechanics	4-0
Ch-102 Gen. Inorganic Chem.	4-2	Ph-341 Electricity & Magnetism	4-0
Mr-101 Meteorology	3-0	Ch-213 Analytical Chem.	3-4
Total	15-5	Total	16-4

Winter Term		Spring Term	
Ma-183 Complex Var.	5-0	Ma-184 Spec. Math. Method of Physics	5-0
Ph-342 Electronics	3-3	Ph-343 Electronics & Radiation Meas.	3-0
Ph-142 Analytical Mechanics	4-0	Ph-640 Atomic Physics	3-3
Ch-315 Organic Chem.	3-4	Ch-442 Physical Chem.	4-2
Total	15-7	Ma-301 Statistics	3-2
		Total	18-7

Radiological Defense Engineering Curriculum - RZ Groups. (Cont'd.)

Second Year (RZ2)

At University of California

Summer Term

First Session

Zoology 1A	- General Zoology	- 4
Physiology 1A & 1C	- General Physiology	- 4

Second Session - No required courses.

Fall Term

Phys. 121	Intro. to Atomic Structure	3
Phys. 128	Radiation Meas.	3
Chem. 123	Nuclear Chemistry	2
Physiology 100A	General & Comparative Physiology	3
	Toxicology and pathology	
	Total	14

Spring Term

Phys. 124	Radioactivity & Nuclear Struct.	3
Phys. 126	Medical Physics	3
Biochem. 103	Animal Biochemistry	4
Physiology 100D	General Physiology	3
	Total	13

Interessional field trip.

Third Year (RZ3)

At University of California

Fall Term

Phys. 215A	Adv. quantum Mech. & Nuclear Physics	3
Phys. 226A & C	Biophysics & Med. Phy.	2
	Public Health	3
	Clinical Radiology	3
	Total	11

Spring Term

Chem. 223	Adv. Radioactivity	2
Phys. 215B	Adv. quantum Mech. & Nuclear Physics	3
Phys. 226B	Biophysics & Nuclear Seminar	1
Bacteriology 31	Survey of General Bacteriology	3
	Total	9

Final Comprehensive Exam.

Second Year (RZ2)

At Ohio State University

Summer Term

	Physiological Chem.	5
Ph-615	Intro. to Nuclear Physics	3
Ph-633	Nucleonic Measure. & Instru.	3
Ph-613	Electromagnetic Field Phen.	3
	Total	14

Fall Term

Ph-600		3
Ph-726	Methods of Theoret. Ph.	3
Ph-740	Intro. to Theoret. Physics	3
Ch-898	Nuclear Chemistry	3
Ch-	Nuclear Chemistry Lab.	2 or 3
	Total	14 or 15

Winter Term

Ph-601		6
Ph-727	Methods of Quantum Mech. I	3
Ph-741	Intro. to Theoret. Physics	3
Ph-721	Nuclear Physics	3
	Total	15

Spring Term

Ph-602		6
Ph-728	Methods of Quantum Mech. II	3
Ph-742	Intro. to Theoret. Ph.	3
Ph-6	Medical Physics (See description under Ph.)	3
	Total	15

Interessional Field Trip. Approx. 5 Months

Third Year (RZ3)

At Ohio State University

Winter Term

Ph-820	Theory of the Atomic Nucleus	3
Ph-6	Medical Physics (See description under Physics	3
Ph-603	Heat & Thermodynamics	3
Ph-950	Research in Physics	6
	Total	15

Spring Term

Ph-821	Theory of the Atomic Nucleus	3
	Medical Physics Physiology Seminar 816	2
Ph-950	Research in Physics	9
	Total	14

PART III

Course Descriptions

Ae Courses

Aeronautical Lecture Series	Ae-001
Basic Aerodynamics	Ae-100
Technical Aerodynamics	Ae-121
Technical Aerodynamics - Performance	Ae-131
Flight Analysis	Ae-132
Aircraft Performance - Flight Analysis	Ae-136
Dynamics I	Ae-141
Dynamics II	Ae-142
Dynamics III	Ae-146
Stress Analysis	Ae-201
Stress Analysis	Ae-202
Stress Analysis	Ae-203
Stress Analysis	Ae-204
Airplane Design	Ae-311
Airplane Design	Ae-312
Advanced Aircraft Structures	Ae-321
Aircraft Engines	Ae-411
Aircraft Propulsion	Ae-421
Internal Flow in Aircraft Engines	Ae-431
Gas Turbines I	Ae-451
Gas Turbines II	Ae-452
Hydro-aero-mechanics	Ae-501
Hydro-aero-mechanics	Ae-502
Compressibility	Ae-503

Ae-001 AERONAUTICAL LECTURE SERIES 0-2

The course consists of a series of lectures by prominent authorities from the Bureau of Aeronautics, research laboratories, and from industry.

Prerequisities: None.

Ae-100 BASIC AERODYNAMICS 3-4

The course includes: Properties of fluids; statics of fluids; flotation; Bernoulli's theorem; fluid velocity and pressures; pitotstatic tube; the venturi tube; cavitation; theory of lift; circulation; blade screws and propellers; vicosity; viscous flows; vertices; flow in pipes; flow through orifices; laminar and turbulent boundary layer flows; separation phenomena; surface friction; resistance of floating bodies; dynamics of compressible fluids.

The P.W. periods include experimental work in the wind tunnel, allied to the topics above; technical analysis and report writing.

Texts: Fluid Mechanics; Dodge, Thompson: Elementary Fluid Mechanics; Rouse.

Prerequisites: None.

Ae-121 TECHNICAL AERODYNAMICS 3-2

The course includes: Characteristic flows and pressures about bodies; surface friction; wake drag; aerodynamic characteristics of airfoil sections, three demensional air foil theory; induced drag; aspect ratio corrections; biplanes; interference drag; high lift devices; velocity polar; relative motion.

The P.W. periods include wind tunnel experiments, analysis and technical report writing on topics allied to the above class work.

Texts: Airplane Design - Performance; Warner: Engineering Aerodynamics; Diehl: Elementary Applied Aerodynamics; Hemke: Wind Tunnel Testing; Pope.

Prerequisite: Ae-100

Ae-131 TECHNICAL AERODYNAMICS - PERFORMANCE 4-2

The course includes: The aerodynamic characteristics of the airplane; the propeller and engine characteristics; sea level performance; performance at altitudes; superchargers; range and endurance; special performance problems; charts.

The P.W. periods are devoted to computations and performance analysis.

Texts: Same as in Ae-121

Prerequisites: Ae-100, Ae-121.

Ae-132 FLIGHT ANALYSIS 3-2

The course includes: Parametric study of aircraft performance, flight test procedure, flight data reduction, special flight problems.

Practical work: Practical problems dealing with the above.

Texts: Airplane Design - Performance; Warner: Engineering Aerodynamics; Diehl: Flight Testing; Hamlin.

Prerequisites: Ae-100; Ae-121; Ae-131.

Ae-136 AIRCRAFT PERFORMANCE - FLIGHT ANALYSIS 3-2

The course includes: Aerodynamic characteristics of composite aircraft; propeller and engine characteristics; aircraft performance; range and endurance; special performance problems; performance parameters; flight test reduction and analysis.

Practical work: Analysis of performance of an aircraft will be made based upon wind tunnel tests in the laboratory - practical problems from flight test will also be analyzed.

Texts: Airplane Design - Performance; Warner: Engineering Aerodynamics; Diehl: Elementary Applied Aerodynamics; Hemke: Wind Tunnel Testing; Pope: Flight Testing; Hamlin.

Prerequisites: Ae-100; Ae-121.

Ae-141 DYNAMICS, I 3-4-5

The course includes: Fundamental definitions, the forces and moments of the entire airplane, the equations of motion, the moments of the wing, tail and other parts of the airplane, C.G. location on static stability, neutral points, maneuver points, fixed control and fire control stability, elevator, aileron rudder effectiveness, control design features, maneuverability and controllability, turns and loops.

The laboratory work consists of wind tunnel experimentation and analysis of the above topics on models.

Texts: USNPS Notes; Higgins: Aircraft Stability and Controllability; Perkins: Flight Testing; Hamlin.

Prerequisites: Ae-100, Ae-121, Ac-131.

Ae-142 DYNAMICS, II 3-4-5

The course includes: The Ealerian equations of motion, the moments of mertia of aircraft, the aerodynamic reactions and derivatives solution of the symmetrical or longitudinal motion, analysis of the longitudinal motion, solution of the asymmetrical or lateral motion, alaysis of the lateral motion, effect of control freedom, effect of controls and response, spins.

The laboratory works consists of wind tunnel experimentation on models to study some of the above problems.

Texts: Same as in Ae-141

Prerequisites: Ae-141

Ae-146 DYNAMICS 3-2

The course includes fundamental definitions, forces and moments of composite aircraft, equations of motion, static stability and trim, effects of CG location, static margins, free control stability, dynamical longitudinal stability, dynamic lateral stability, force and moment derivations, stability charts, controllibility, maneuverability, three dimensional motions, spins.

The P.W. consists of experimentation and analysis of static and dynamic stability of some particular aircraft.

Texts: Same as in Ae-141

Prerequisites: Ae-100; Ae-121; Ae-131 or Ae-136.

Ae-201 STRESS ANALYSIS 4-2

The course is in continuity with ME-531, and emphasizes digrammatic methods, applied especially to: analysis of beams including statically indeterminate cases, frame elements, variable cross section, shearing effect on bending displacement; plane stress, principal stresses; influence lines and elementary applications.

Texts: Strength of Materials Vol. I; Timoshenko: Airplane Structures Vol. I; Niles, Newell: Analysis and Design of Airplane Structures; Bruhn: USNPS Stencils.

Prerequisites: Ma-102; Mc-112; ME-531.

Ae-202 STRESS ANALYSIS 4-2

This course is in continuity with Ae-201 and considers: strain energy, applications to impact loading, castigliano theorem, displacement calculations, redundant trusses; virtual energy, applications to deflection and statically indeterminate problems, Maxwell-Mohr method; law of reciprocal deflections; influence line application to deflections; buckling of bars, the flexible column, critical loads, energy methods; curved bars.

Texts: Strength of Materials Vols. I and II; Timoshenko: Airplane Structures Vols. I and II; Niles, Newell: Analysis and Design of Airplane Structures; bruhn: USNPS Stencils.

Prerequisite: Ae-201.

Ae-203 STRESS ANALYSIS 4-0

This course is in continuity with Ae-202 and considers: curved bars (continued), rotating machine parts, circular bars in bending and/or twist, energy methods on curved frames, beams loaded by forces not in principal axes of section, cases with unsymmetrical cross-section; short beams in compression and bending, cores; torsions, non-circular sections, membrane analogy, combined with bending, close coiled helical spring, crank throw, thin open or hollow sections, torsional shear flow; center of twist, shear flow; beam columns, single panel, multipanel, charts; beam tie; polar diagrams.

Texts: Same as in Ae-203.

Prerequisites: Ae-202; Me-111.

Ae-204 STRESS ANALYSIS 4-0

This course is in continuity with Ae-203 and considers: Thin stiff plates under lateral load, bent to cylinder, in pure bending in two perpendicular directions, axially symmetrical problems; axially symmetrical membrane problems; discontinuity effects in shells, beam on elastic foundation and application, cylinder and hemisphere, flat plate and cylinder, hollow ring and cylinder; thick-walled spheres and cylinders, applications to rotating discs; selected topics from theory of elasticity; stress concentration.

Texts: Strength of Materials, Vol. I and II, Timoshenko; Airplane Structures, Vol. I and II, Niles and Newell; Analysis and Design of Airplane Structures; Bruhn: Airplane Structural Analysis and Design, Sechler and Dunn: Applying Theory of Elasticity in Practical Design, Orton: USNPS Stencils.

Prerequisite: Ae-203

Ae-311 AIRPLANE DESIGN, I 2-4

Topics are: critical loading conditions, load-factors, V-g diagrams, strength envelopes, detail methods of layout and analysis of a light plane.

P.W. requirements are for the condition of high angle attack: prepare equipment list and balance diagram; correct airfoil characteristics for structural use; construct three view drawing; run the balance calculation and the preliminaries to the wing design.

Texts: Same as Ae-202 and Airplane Design Manual; Teichmann: Airplane Structural Analysis and Design; Sechles and Dunn: C.A.R. 04: C.A.M. 04: Aviation Sketch Book of Aircraft Design Detail; Aviation: Navy Specifications and Manuals.

Prerequisite: Ae-202

Ae-312 AIRPLANE DESIGN, II 2-4

Topics include: wing spar analysis, wing truss analysis, fuselage analysis including Maxwell Diagram; design of one wing spar on basis, (a) shearresistant web, (b) tension field web, (c) composite spar of two materials; design of elevator torque tube in bending and twist for given loading condition, design of several members of the fuselage truss as columns and as ties; design of indicated fittings.

Texts: Same as in Ae-311

Prerequisites: Ae-311; Ae-203.

Ae-321 ADVANCED AIRCRAFT STRUCTURES 4-0

Topics include: rectangular plates in pure bending, in bending and under loading in middle surface, buckling, crippling; advanced deflection problems, Williot diagram; deformation in the plastic state; advanced stability considerations, beam columns, rings and tubes, latticed columns, variable section torsional cases.

Texts: Those of Ae-204 and Ae-311

Prerequisites: Ae-312; Ae-204.

Ae-411 AIRCRAFT ENGINES 3-2

This course extends the study of combustion with particular reference to piston engine and gas turbine applications. Fuel mixtures, ignition, flame propogation and stability are discussed. Utilization and conversion of combustion energy in engine cycles is considered in both the thermodynamic and mechanical aspects. The latter is continued in a survey of current engine design and construction.

Texts: Internal Combustion Engines; Lichty: Internal Combustion Engines; Taylor & Taylor: USNPS Stencils.

Prerequisite: ME-132.

Ae-421 AIRCRAFT PROPULSION 3-2

Sea level and altitude performance characteristics of piston engines, propellers, turbo-jet and turbo-prop engines are analyzed. Maximum performance, cruise control, laboratory and flight testing, and test data correction methods are discussed. Aircraft performance is reviewed with particular reference to the propulsion system. The practical work of this course consists of supervised analysis of test data taken at various Naval Air Test Centers.

Texts: Aircraft Power Plants; Fraas: Airplane Propeller Principles; Nelson: Jet Propulsion; Air Technical Service Command: USNPS Stencils.

Prerequisites: Ae-411; Ae-131.

Ae-431 INTERNAL FLOW IN AIRCRAFT ENGINES 4-0

Momentum theorem, thrust equations, gas turbine cycle analysis, flow equations, relative and absolute flow, relative flow in machines, energy equations, thermodynamic flow equations, axial-flow compressors, centrifugal compressors, axial-flow turbines, centrifugal turbines, control analysis of aircraft gas turbines.

Texts: Jet Propulsion; ATSC: Jet Propulsion and Gas Turbines; Zucrow: USNPS Stencils.

Prerequisite: Ae-503.

Ae-451 GAS TURBINES I 3-0

A seminar on the theory, design and control of gas turbine, stationary and narine.

Prerequisites: ME-132; Ae-502.

Ae-452 GAS TURBINES II 3-0

A seminar in continuation of Ae-451.

Prerequisite: Ae-451.

Ae-501 HYDRO-AERO-MECHANICS, I 4-0

Vector Calculus and aerodynamical applications, fluid kinematics and flow description, stream and velocity potential functions, dynamic equations for a perfect fluid, solution by scalar and vector methods, properties of elemental and combined flows, two dimensional problems, use of complex numbers in flow description, conformal transformation, complex integration, Blasius Equations, Kutta-Joukowski Theorem, lift and pitching moment on an infinite wing.

Texts: Airfoil and Airscrew Theory; Glauert: Fluid Dynamics; Streeter.

Prerequisites: Ma-114; Ae-131.

Ae-502 HYDRO-AERO-MECHANICS, II 4-0

Viscous Fluids, Navier-Stokes Equation and special solutions, Prandtl Boundary Layer Theory, skin friction, Helmholtz Vortex Theory, the three dimensional airfoil, induced velocity angle of attack, drag, lift distribution, least induced drag tapered and twisted airfoils, chordwise and spanwise load distributional tunnel-wall effect, compressible fluids.

Texts: Same as Ae-501.

Prerequisite: Ae-501.

Ae-503 COMPRESSIBILITY 4-0

Propagation of disturbances, Normal shocks, Flow in channels with varying cross section, Laval nozzle with varying back pressure, Oblique shocks, Reflection of shock fronts, Mach waves, Prandtl-Meyer flow, Hodograph methods, Method of characteristics, Travelling shock fronts, Instationary flow problems.

Texts: Aerodynamics of a compressible Fluid; Liepman, Puckett: USNPS Stencils.

Prerequisites: ME-132; Ae-502.

CHEMISTRY

Ch Courses

General Inorganic Chemistry	Ch-101
General Inorganic Chemistry	Ch-102
Fuel and Oil Chemistry	Ch-111
Fuel and Oil Chemistry	Ch-121
Quantitative Chemistry	Ch-213
Qualitative Analysis	Ch-221
Quantitative Analysis	Ch-231
Organic Chemistry	Ch-301
Organic Chemistry	Ch-311
Organic Chemistry	Ch-312
Organic Chemistry	Ch-315
Organic Qualitative Analysis	Ch-321
Organic Chemistry, Advanced	Ch-322
Organic Chemistry, High Polymers	Ch-323
Physical Chemistry	Ch-411
Physical Chemistry	Ch-412
Physical Chemistry (Adv.)	Ch-413
Physical Chemistry	Ch-442
Plastics	Ch-521
Physical Chemistry	Ch-531
Reaction Motors	Ch-541
Radio Chemistry	Ch-551
Physical Chemistry	Ch-561
Physical Chemistry	Ch-571
Physical Chemistry, Special Fuels	Ch-581
Chemical Engineering Thermodynamics	Ch-611
Chemical Engineering Thermodynamics	Ch-612
Chemical Thermodynamics	Ch-613
Thermodynamics	Ch-631
Chemical Engineering Calculations	Ch-701
Seminar	Ch-800

Ch-101 GENERAL INORGANIC CHEMISTRY 3-2

The subject matter includes a consideration of general chemical principles such as the modern concept of the atom, kinetic theory, chemical equilibrium, chemical calculations, reaction rates and a brief discussion of the specialized topics (corrosion, explosives, etc.), which are of special interest to officers in the naval service.

The laboratory work consists of experiments selected to illustrate principles discussed in the lectures. (Principles of Chemistry; Hildebrand).

Prerequisites: None.

Ch-102 GENERAL INORGANIC CHEMISTRY 4-2

The topics covered include chemical equilibrium, chemical calculations, kinetic theory, atomic structure, solutions, ionization and also sufficient descriptive material to furnish background for advanced courses.

The laboratory work consists of experiments which will illustrate principles discussed in lecture and which will enable students to develop laboratory technique. (Principles of Chemistry; Hildebrand: Reference Book of Inorganic Chemistry; Latimer and Hildebrand: Introduction to Semimicro Qualitative Chemical Analysis; Curtman.)

Prerequisites: None.

Ch-111 FUEL AND OIL CHEMISTRY 2-2

The subject matter includes the chemistry, properties and production of fuels and lubricants; the theory of combustion and knocking; the theory of fluid film and boundary lubrication and the interpretation of the results of standard test procedures.

The laboratory work includes conducting some of the standard tests on fuels and lubricants and problems on interpretation of data from Orsat analysis and combustion calculations. (Chemical Technology of Petroleum; Gruse and Stevens: Significance of Tests on Petroleum Products; A.S.T.M.: VV-L-791b; Federal Specifications for Lubricants and Liquid Fuels.)

Prerequisite: Ch-101

Ch-121 GENERAL AND PETROLEUM CHEMISTRY 4-2

The subject matter includes a consideration of chemical principles such as atomic structure, states of matter, ionization, chemical equilibrias, etc.; and a survey of the chemistry, properties and production of fuels and lubricants. The theory of lubrication; and the theory of combustion and knocking; and interpretation of the results of standard test procedures.

The laboratory work consists of experiments illustrating principles discussed in the lectures; and performing some of the standard tests on fuels and lubricants. (Principles of Chemistry; Hildebrand: Chemical Technology of Petroleum; Gruse and Stevens: A.S.T.M. Significance of Tests on Petroleum Products VV-L-791b; Federal Specifications for Lubricants and Liquid Fuels.)

Prerequiste: None.

Ch-213 QUANTITATIVE ANALYSIS 3-4

This course consists of a study of the principles of mass action, common-ion effect and solubility product and their application to quantitative analysis.

The laboratory work consists of quantitative determinations by volumetric and gravimetric methods. (Quantitative Analysis; Pierce and Haenisch.)

Prerequisite: Ch-102

Ch-221 QUALITATIVE ANALYSIS 3-2

This is the first part of a course in analytical chemistry and is fundamentally qualitative analysis. It consists of the application of chemical principles to systematic analysis.

The laboratory work consists of the analysis of known and unknown solutions. (Introduction to Semi-micro Qualitative Analysis; Curtman.)

Prerequisite: Ch-101 or Ch-121

Ch-231 QUANTITATIVE ANALYSIS 2-4

This course is a continuation of the work of Ch-221. The subject matter includes the principles involved in quantitative analysis.

The laboratory work consists of quantitative determinations by volumetric and gravimetric methods. (Quantitative Analysis; Pierce and Haenisch.)

Prerequisites: Ch-101 or Ch-121; Ch-221.

Ch-301 ORGANIC CHEMISTRY 3-2

A brief course in organic chemistry consisting of a discussion of important principles, methods, and classes of compounds in the aliphatic and aromatic series. (Introduction to Organic Chemistry; Lowy, Harrow,Apfelbaum)

Prerequisite: Ch-101 or Ch-121

Ch-311 ORGANIC CHEMISTRY 3-2

A brief course in the chemistry of the aliphatic compounds. Major emphasis is placed on well-recognized basic principles of organic chemistry. (Lowy, Harrow, Apfelbaum)

Prerequisites: Ch-101; Ch-111.

Ch-312 ORGANIC CHEMISTRY 3-2

This course is a continuation of chemistry Ch-311 with the application of the study to aromatic compounds. Particular emphasis is given to polymer chemistry and the more recent and more important applications. (Lowy, Harrow, Apfelbaum)

Prerequisite: Ch-311

Ch-315 ORGANIC CHEMISTRY 3-4

A course in organic chemistry consisting of important principles, types of compounds and methods of analysis and synthesis. Particular emphasis is given phases of the subject leading to the study of the biological sciences. (Lowy, Harrow & Apfelbaum.)

Prerequisites: Ch-101, Ch-213.

Ch-321 ORGANIC QUALITATIVE ANALYSIS 2-2

A brief course in methods of classification, identification, and derivative preparation of organic compounds. Emphasis is placed upon the use of chemical literature and the organization of organic chemistry. (Qualitative Organic Analysis; Kamm.)

Prerequisite: Ch-201; 311-312; or Ch-315.

Ch-322 ADVANCED ORGANIC CHEMISTRY 3-2

An advanced course in the theory of organic chemistry. The course is designed to give a uniform point of view of both the older bond theories and the newer structural theories and their relations to organic chemistry. (Theory of Organic Chemistry; Branch and Calvin.)

Prerequisite: Ch-301; Ch-311; or Ch-315.

Ch-323 ORGANIC CHEMISTRY - HIGH POLYMERS 3-0

An outline of the theory and practice of high polymer chemistry. Current literature and monographs are used by the class in studying and evaluating materials and applications in this field.

Prerequisite: Ch-301; Ch-311-312; or Ch-315 and Ch-521.

Ch-411 PHYSICAL CHEMISTRY 2-2

A study of the physico-chemical properties of matter and of the laws governing chemical behavior. Topics include gases, solids, molecular structure, chemical thermodynamics, thermochemistry and liquids.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures. (Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams)

Prerequisites: Ch-101 or Ch-121.

Ch-412 PHYSICAL CHEMISTRY 2-2

This course is a continuation of Ch-411. Topics include solutions, chemical equilibrium, kinetics, electrical conductance and electromotive force.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures. (Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams)

Prerequisites: Ch-411

Ch-413 ADVANCED PHYSICAL CHEMISTRY 2-2

A course devoted to selected topics in advanced physical chemistry. Electronic structure of atoms and molecules, the solid state, physical properties of liquids, etc. The laboratory work consists of experiments essigned to supplement the material covered in the classroos. (Elements of Physical Chemistry, Glasstone).

Prerequisite: Ch-411 and Ch-412.

Ch-421 PHYSICAL CHEMISTRY 4-2

A survey of physical chemistry and a study of the laws governing chemical behavior and the physicochemical properties of matter. Topics include gases, solids, liquids, solutions, chemical equilibria, thermo-chemistry, chemical thermodynamics, and chemical kinetics. Problems illustrative of the principles studied from an integral part of the course.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures. (Outlines of Physical Chemistry; Daniels).

Prerequisite: Ch-101 or Ch-121.

Ch-442 PHYSICAL CHEMISTRY 4-2

The course involves a study of the laws governing chemical behavior and the physico-chemical properties of matter. Some of the topics considered are gases, liquids, solids, solutions, thermo-chemistry, chemical thermodynamics, colloid chemistry, chemical equilibrium and chemical kinetics.

Problems are assigned and laboratory experiments are performed to illustrate the principles discussed in the lectures. (Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniesl, Mathews, Williams).

Prerequisites: Ch-101 or Ch-102 and Ch-213.

Ch-521 PLASTICS 3-2

The subject matter includes a study of the nature and types of plastics, their properties, applications and limitations as an engineering material. Included is a discussion of natural and synthetic rubbers.

The laboratory exercises consist of the preparation of typical plastics, a study of their physical and chemical properties, and identification tests. (Fundamentals of Plastics; Richardson, Wilson: Plastics as Engineering Materials; Kinney - P.G. Stencil 3883).

Prerequisite: Ch-101 or Ch-121.

Ch-531 PLYSICAL CHEMISTRY 2-0

A continuation of the study of physical chemistry, emphasizing certain aspects of particular importance in metallurgy. Stoichiometry of the blast furnace; chemical equilibria in reduction processes, in deoxidation, and in carburizing-decarburizing; principles of controlled atmospheres; activity and activity coefficients in metal solutions; concentration gradients and diffusion effects. Numerical problesm form an integral part of the course.

Prerequisites: Ch-412 or Ch-421, and Mt-202.

Ch-541 REACTION MOTORS S 2-2

The subject matter includes the theory and design of rocket motors and thermal jet engines, nozzles, solid and liquid propellants and the applications of these devices to military uses. Numerical problems form an integral part of the course. (Rocket Propulsion Elements; Sutton: Jet Propulsion; ATSC: Rocket Ballistics Tables; CIT).

Prerequisites: Me-141; and Me-142 or Ch-631.

Ch-551 RADIOCHEMISTRY 3-0

A seminar course with discussions on the important aspects of radioactivity from the standpoint of the chemical transformations which accompany it and which it may induce; the possible health hazards associated with radioactivity, safety measures and decontamination problems; techniques for measurement and study of ionizing radiation.

Prerequisites: None.

Ch-561 PHYSICAL CHEMISTRY 3-2

The subject matter includes a review and further discussion of topics such as gases, liquids, solutions, thermochemistry, chemical thermodynamics, etc. Particular emphasis is placed on chemical equilibria involving typical combustion products and on chemical kinetics. Numerical problems form an integral part of the course.

The laboratory work consists of experiments designed to illustrate certain phases of the principles discussed in the lectures. (Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams).

Prerequisites: Ch-101; Ch-111 or Ch-121.

Ch-571 PHYSICAL CHEMISTRY 3-2

The subject matter includes topics such as gases, liquids, solutions, thermochemistry and chemical thermodynamics. Particular emphasis is placed on chemical equilibria involving typical combustion products, chemical kinetics and calculation of flame temperatures.

The laboratory work consists of experiments illustrating principles discussed in the lectures. (Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams).

Prerequisites: Ch-111 or Ch-121; Me-131; Me-132.

Ch-581 CHEMISTRY OF SPECIAL FUELS 2-2

A brief survey of the organic and physical chemistry necessary for an appreciation of the problems associated with special fuels. The nature of high-energy fuels, their limitations, and possible future developments; methods of reaction rate control; etc.

Prerequisites: None.

Ch-611 CHEMICAL ENGINEERING THERMODYNAMICS 3-2

A study of the foundamentals of thermodynamics, the concept of energy and transformations; thermodynamic properties of substances, ideal gases; thermochemistry. Numerical problems form an integral part of the course. (Kiefer, Stewart and Kinney; Principles of Engineering Thermodynamics; 2nd Edition: Thermo Dynamics for Chemical Engineers; Weber: Chemical Engineers Handbook; Perry: Thermodynamic Properties of Steam; Keenan and Keyes Gas Tables; Keenan and Kaye).

Prerequisite: Ch-101.

Ch-612 CHEMICAL ENGINEERING THERMODYNAMICS 3-2

A continuation and extension of course Ch-611, with applications of the principles of thermodynamics to the unit operations of chemical engineering. Numerical problems form an integral part of the course. (Principles of Engineering Thermodynamics, 2nd Edition; Kiefer, Stewart and Kinney; Thermodynamics for Chemical Engineers; Weber: Chemical Engineers Handbook; Perry: Thermodynamic Properties of Steam; Keenan and Keyes: Gas Tables; Keenan and Kaye).

Prerequisite: Ch-611.

Ch-613 CHEMICAL THERMODYNAMICS 3-2

The subject matter is an extension of previous studies in thermodynamics and chemistry. It includes a specialized treatment of the thermal and thermodynamic properties of materials; thermochemistry; equilibrium and the phase rule; phase relations; chemical equilibrium and energy relations, particularly at higher temperatures and pressures. Numerical problems form an integral part of the course.

Prerequisites: Ch-561, plus two terms of engineering thermodynamics.

Ch-631 THERMODYNAMICS 3-2

An abbreviated intensive course in the basic concepts of thermochemistry and chemical thermodynamics. The subject matter includes a study of the thermal properties and energy relations of combustion products, thermodynamic properties of gases, and chemical equilibria at high temperature. This course supplies a prerequisite necessary for subsequent courses in rocket motors and interior ballistics. Numerical problems illustrate the basic theory and methods developed in the classroom. (Thermodynamics of Firearms; Robinson).

Ch-701 CHEMICAL ENGINEERING CALCULATIONS 3-2

Chemical calculations in both English and metric units; material balances and energy balances for combustion, evaporation, etc.; stoichiometry of the unit operations of chemical engineering. (Industrial Stoichimetry; Lewis and Radasch: Chemical Process Principles Part I; Hougen and Watson).

Prerequisite: Ch-101 or Ch-121.

Ch-800 CHEMISTRY SEMINAR 2·0

Articles from current technical journals will be reported and discussed by students.

Prerequisites: None.

COMMUNICATIONS

Co, Ta, and GL Courses

Typing and Radio Code	Co-101
Radio Code and Procedure	Co-102
Visual and Voice Procedure	Co-103
Communication and Other Pertinent Naval Organizations	Co-104
Communication Procedure	Co-110
Teletypewriter; Appendices to Com. Inst.	Co-111
International and Commercial Communications	Co-112
Correspondence and Mail	Co-113
Crypto Systems Instruction	Co-114
Basic Naval Communication Instructions	Co-120
Communication Plans (Basic Rapid Comm. Plan)	Co-121
Communication Plans (Type and Task Force)	Co-122
Communication Plans (Amphibious and Deceptive)	Co-123
Tactics	Ta-101
Tactics	Ta-102
Tactics	Ta-103
Tactics	Ta-104
Navigation (Basic and Refresher Course)	GL-101
Celestial and Loran Navigation	GL-102

Co-101 TYPING AND RADIO CODE 0-4

This course is the first in the operating communication series. Students attaining a proficiency of 30 words per minute during the course will then be started on radio code. Students who have not reached 30 WPM (typing) by the end of the term will be examined periodically during later terms until they attain this speed.

Prerequisites: None.

Co-102 RADIO CODE AND PROCEDURE 0-4

This is the second course in the operating communication series. It is a continuation of Co-101 and is designed to make the student proficient by actual operation in radio CW procedure, circuit discipline, message drafting, log keeping, message servicing, and handling all types of radio CW messages through the use of simulated drill or fleet circuits.

Prerequisite: Co-101.

Co-103 VISUAL AND VOICE PROCEDURES 0-3

This course is the third in the operating communication series. It is designed to make the student proficient by actual operation in radio voice procedure, flashing light procedure, and semaphore procedure. Transmission of general signals by these methods, which is studied in Co-120, is given practical demonstration both in Co-102 and Co-103 and the tactical practical works.

Prerequisites: Co-101; Co-102.

Co-104 COMMUNICATION AND OTHER PERTINENT NAVAL ORGANIZATIONS 2-1

This course is the final one of the operational communication series. It covers the organizational problems of the communication service ashore and afloat and the latest developments. The recitation periods are devoted in part to seminar presentation of the organization and duties of communications organizations and partly to the other phases of naval organization. The practical work periods are used for lectures by competent officers from the field on the various phases of the communication service in which they are currently performing duty.

Prerequisites: None.

Co-110 COMMUNICATION PROCEDURE 2-2

In this course the student officer learns the principles of effective message drafting. He studies the construction and use of operating Signals, Prosigns, Call Signs, Routing Indicators, and Delivery Groups. He becomes familiar with the format and use of the General Signal Book. He learns the application of the principles and rules learned in various forms of Naval Messages. (Various Navy Publications).

Prerequisites: None.

Co-111 TELETYPEWRITER; APPENDICES TO COMINST 2-1

This course covers tape relay procedures and instructions, handling of toll traffic, and other special instructions pertinent to functions of Communication Officers.

Prerequisites: None.

Co-112 INTERNATIONAL & COMMERCIAL COMM. 1-1

This course covers International Agreements, Frequendies and Navigational Aids. In addition it covers communications with merchant ships and communications with the Coast Guard. The operation of various commercial companies and their interrelationship with U.S. Naval Communication Service is covered.

Prerequisites: None.

Co-113 CORRESPONDENCE AND MAIL 1-0

This course consists of lectures and written exercises on office management, files and filing, and correspondence; with a brief summary of the duties of the shipboard Communication Officer with regards to Postal Service.

Prerequisites: None.

Co-114 CRYPTO SYSTEMS INSTRUCTION 0-2

The student is taught the actual handling and manipulation of cryptographic aids and devices and is given sample texts to encrypt and decrypt using all effective systems. In addition, the overall crypto plan of the U. S. Navy is studied through practical works on the subject.

Prerequisite: Co-110.

Co-120 BASIC NAVAL COMMUNICATION INSTRUCTIONS 2-1

In this course the student officer is acquainted with the organization of the Naval Communication System, the reasons for its existence, and the communication policies established including the principles and rules for security and registered publication handling. (Various Navy Publications).

Prerequisites: None.

Co-121 COMMUNICATION PLANS (BASIC RAPID COMM. PLAN) 2-2

This is the second of the series of formal study courses covering communication subjects. It is based primarily on the study of the basic rapid communication plan. The practical works consist of correlating exercises involving the interpretation of simple communication plans and the preparation of simple exercise plans.

Prerequisites: Co-110; Co-120.

Co-122 COMMUNICATION PLANS (TYPE AND TASK FORCE) 2-3

This course is a continuation of the formal study of Communication Planning. It covers the application of principles learned to the development of typical communication plans for Surface Action Force, Carrier Task Force, Escort of Convoy, and Submarine Force Operations. The practical work covers the interpretation of typical COMPLANS and the preparation of exercise plans.

Prerequisites: Co-110; Co-120; Co-121.

Co-123 COMMUNICATION PLANS - AMPHIBIOUS AND DECEPTIVE 1-3

This course is the final formal study of communication planning. It covers the application of principles learned to the development of typical communication plans for Amphibious and Deception Operations. The practical work covers the interpretation of COMPLANS and the preparation of exercise plans. The completion of this course realizes the objective of furnishing the student with background knowledge required to draw up or assist in drawing up a communication plan suitable to any mission assigned or derived.

Prerequisites: Co-120; Co-121; and Co-122.

Co-202 TACTICS 2-2

By formal study of the Principles and Applications of Naval Warfare, General Tactical Instructions, and CIC Instructions, the student is prepared for the study in later terms of the procedures developed to solve the tactical problems of specific forces. The practical works emphasized the usefulness of the maneuvering board and CIC in the solution of such problems. They also point up the relation of communications to operations, and demonstrate the intimate relationship of general signals with tactics.

Prerequisites: None.

Co-203 TACTICS 2-2

By study of Surface Action and Tactics and the Carrier Task Force Tactical Instructions the student officer learns how the principles studied in the first term are applied to the operations of the Striking Forces. By study of the Long Range Air Reconnaisance and Scouting Instructions and the Logistic Support Force Instructions he learns of the support required for large scale operations. Practical works on the game board emphasize the magnitude of tactical problems encountered by Striking Force commanders and introduce the element of timing in operations.

Prerequisite: Co-202

Co-204 TACTICS 2-2

This course introduces the student officer to the tactical problems of Submarine, Anti-Submarine, and Convoy Escort Commanders, and outlines the procedures developed to solve these problems.

Prerequisites: Co-202; Co-203.

This course introduces the student officer to the tactical problems involved in Amphibious Operations and outlines the procedures developed to solve these problems.

Prerequisites: Co-202; Co-203 and Co-204.

CRYSTALLOGRAPHY

Cr Courses

Crystallography and X-Ray Techniques	Cr-271
Crystallography and Mineralogy	Cr-301

Cr-271 CRYSTALLOGRAPHY AND X-RAY TECHNIQUES 3-2

The student is first introduced to the fundamental concepts of crystallography, including: symmetry, point groups, plane lattices, space lattices, space groups, coordinate systems, indices, crystal classes, crystal systems, common forms and combinations in the various systems. The stereographic projection is then studied.

With this foundation, some time is spent on a discussion of the crystal structure of the elements, metals, alloys, and inorganic compounds.

The latter part of the course is devoted to acquainting the student with modern x-ray diffraction and radiographic apparatus and techniques, including: the theory of x-ray diffraction, the Bragg equation, powder methods, single crystal and moving film methods, high temperature diffraction technique as applied to obtaining phase diagrams, back reflection and transmitted beam methods, and practical applications of these methods.

The laboratory work includes: a study of crystal models for symmetry, forms, and combinations; the construction of stereographic projections; and actual practice in the making and interpreting of x-ray diffraction photographs.

Texts: Mineralogy; Dana, Ford: Structure of Metals; Barrett.

Prerequisite: Ch-101

Cr-301 CRYSTALLOGRAPHY AND MINERALOGY 3-4

The student is first introduced to the fundamental concepts of crystallography including: Symmetry; point groups; plane lattices; space lattices; space groups; coordinate systems; indices; crystal classes; crystal systems; common forms and combinations in the various systems and classes. The sterergraphic projection is then studied with special reference to its application to crystallographic problems. The theory of x-ray diffraction and the application of x-ray powder methods is taken up as applied to identification of minerals.

The remainder of the time is spent on the description of some fifty of the more common minerals.

The laboratory work includes a study of crystal models for symmetry forms, and combinations; the practical application and construction of stereographic projections; determination of minerals by x-ray powder diffraction patterns; and as time permits, a start is made in the identification of minerals.

Texts: Mineralogy; Dana, Ford.

ELECTRICAL ENGINEERING

EE Courses

Fundamentals of Electrical Engineering	EE-111
DC Circuits and Fields	EE-151
Electric Circuits and Fields	EE-171
AC Circuits and Transformers	EE-214
DC Machines and AC Circuits	EE-231
AC Circuits	EE-251
AC Circuits	EE-271
AC Circuits	EE-272
AC and DC Machinery	EE-314
DC Machinery	EE-351
DC Machinery	EE-371
Transformers and Synchros	EE-451
Polyphase Transformers, Synchronous Machines and Induction Motors	EE-452
Sychronous Machines and Induction Motors	EE-455
Transformers, Asynchronous Machines, and Synchros	EE-471
Synchronous Machines	EE-472
Synchros	EE-473
Transmission Lines and Filters	EE-551
Transmission Lines and Filters	EE-571
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EE-111 FUNDAMENTALS OF ELECTRICAL ENGINEERING 3-2

This course presents a basic treatment of the general theory of electric and magnetic circuits. Electric units, Ohm's Law, and Kirchoff's laws are studied in detail. The magnetic field and the magnetic properties of iron and steel are included.

Texts: Electrical Engineering Vol. I; Dawes.

Prerequisites: None.

EE-151 DC CIRCUITS AND FIELDS 3-4

This course provides a thorough foundation in electricity and magnetism with the major emphasis on electric and magnetic circuits. The basic lawa are given and many problems and laboratory experiments are assigned to illustrate the theory. The course serves as a preparation for further study in electrical engineering.

Texts: Basic Electrical Engineering; Corcoran.

Prerequisites: None.

EE-171 ELECTRIC CIRCUITS AND FIELDS 3-4

This course provides a very thorough foundation in electricity and magnetism for a curriculum majoring in electrical science. The basic laws are given in detail. Many problems are assigned and laboratory experiments are performed to illustrate the classroom theory. The course serves as a foundation for further advanced study.

Texts: Basic Electrical Engineering; Corcoran.

Prerequisites: None.

EE-214 AC CIRCUITS AND TRANSFORMERS 3-4

This course presents in an elementary way single-phase series and parallel circuits, resonance, vector representation, alternating current instruments and balanced polyphase circuits. Transformer principles, operating characteristics and connections are studied. Laboratory work and problems illustrate the classroom theory.

Texts: Electrical Engineering, Volume II; Dawes.

Prerequisites: EE-111.

EE-231 DC MACHINES AND AC CIRCUITS 3-2

This course presents the general principles of DC machines, both motors and generators, and of their control and application. The qualitative characteristics of the various machines are developed from basic principles. Then a study of the theory of alternating currents is begun. Experiments are performed to demonstrate the general machine characteristics and the use of control devices.

Texts: Electrical Engineering, Volumes I and II, Dawes.

Prerequisites: EE-111

EE-251 ALTERNATING CURRENT CIRCUITS 3-4

This course presents the essential theory for those curricula that do not require an extensive coverage. It consists of an elementary presentation of single-phase series and parallel circuits, resonance, vector representation and vector algebra, the most commonly used network theorems, non-sinusoidal wave analysis, coupled circuits, and balanced polyphase circuits. Laboratory and problem work illustrate the basis theory.

Texts: AC Circuits, Kerchner and Corcoran.

Prerequisites: EE-151

EE-271 ALTERNATING CURRENT CIRCUITS 3-2

This course and EE-272 which follows present in a thorough way the basic theory of the alternating current circuit for those curricula that require an extensive coverage. The theory is developed from fundamental physcial principles. The course covers single-phase series and parallel circuits, resonance, vector algebra and vector representation of electrical magnitudes, network theorems, non-sinusoidal wave analysis, balanced polyphase circuits, and power measurements in polyphase circuits. Many problems and laboratory work illustrate the basic theory.

Text: AC Circuits, Kerchner and Corcoran.

Prerequisites: EE-171.

EE-272 ALTERNATING CURRENT CIRCUITS 2-2

This course is a continuation of EE-271. It completes the basic theory of the alternating current circuit for those curricula requiring a thorough preparation for further advanced study. The course includes unbalanced polyphase circuits, instruments and measurements, coupled circuits, bridge theory, and symmetrical components. Many problems and laboratory work illustrate the basic principles.

Text: AC Circuits, Kerchner and Corcoran.

Prerequisites: EE-271.

EE-314 DC AND AC MACHINERY 3-4

This course presents a brief treatment of electrical machines for those curricula that do not require advanced work in electrical engineering. It consists of an elementary study of DC machines and their characteristics, the alternator, the synchronous motor, and the induction motor. The elements of synchros are included. Laboratory and problem work illustrate the principles.

Texts: Electrical Engineering, Volumes I and II, Dawes.

Prerequisites: EE-214.

EE-351 DC MACHINERY 2-2

This course presents the fundamentals of direct current machinery with emphasis upon operating characteristics and applications. The external characteristics are developed from basic relations. Problems are assigned and laboratory work supplements that of the classroom.

Text: Direct Current Machinery, Pender.

Prerequisites: EE-151 or EE-171

EE-371 DC MACHINERY 3-2

This course gives a thorough presentation of the theory and performance of direct current machines and control devices. Armature windings, armature reaction, and commutation are fully covered. The operating characteristics of generators and motors are developed from basic relations so as to provide a foundation for subsequent work in design. Problems are assigned to illustrate the application of the theory. Laboratory work supplements the work of the classroom.

Text: Principles of DC Machines, Langsdorf.

Prerequisites: EE-171.

EE-451 TRANSFORMERS AND SYNCHROS 2-2

This course gives a general treatment of transformers and synchros for the curricula that do not require an extensive treatment. It covers single-phase transformer principles and operating characteristics including the auto-transformer, constant current transformer, and special transformers. Single phase and polyphase synchro construction features, operating characteristics, and basic theory are included. A comprehensive analysis is included of the voltage, current, and torque relations for regular and fault synchro conditions. Laboratory and problem work illustrate the theory of the classroom.

Text: Foundamentals of AC Machinery,

Prerequisites: EE-251.

EE-452 POLYPHASE TRANSFORMERS, SYNCHRONOUS MACHINES, AND INDUCTION MOTORS 3.4

This course is a continuation of EE-451. It completes a general presentation of AC machinery for those curricula that do not require an extensive treatment. Polyphase transformer connections, alternators, synchronous motors, polyphase and single-phase induction motors are presented. A brief survey of induction generators, induction regulators, and the commutator type AC motor is included. Laboratory and problem work illustrate the basic theory.

Text: Fundamentals of AC Machinery, Sah.

Prerequisites: EE-451.

EE-455 SYNCHRONOUR MACHINES AND INDUCTION MOTORS 2-2

This course gives an elementary presentation of the principles and operating characteristics of the synchronous machine, motor and generator, and of the induction motor. Emphasis is placed upon the control and application of the machines. A limited amount of laboratory and problem work supplements the theory.

Text: Fundamentals of AC Machinery, Sah.

Prerequisites: EE-451.

EE-471 TRANSFORMERS, ASYNCHRONOUS MACHINES, AND SYNCHROS 3-4

This course gives a thorough presentation of the principles and operating characteristics of transformers, asynchronous machines, and synchros for the curricula requiring advanced electrical engineering work leading to design. In detail the basic theory of single-phase and polyphase transformers, including auto transformers, constant current, and special transformers is presented. Polyphase induction motor principles, including armature windings, voltage and mmf waves, and operating characteristics are emphasized. Induction generators, single-phase induction motors, and the commutator type AC motor are included. Synchro theory with an analysis of the voltage, current, and torque relations for normal and fault conditions is presented. Laboratory and problem work supplement the basic theory.

Text: AC Machinery, Bryant and Johnson.

Prerequisites: EE-272.

EE-472 SYNCHRONOUS MACHINES 3-4

This course is a continuation of EE-471. Alternator and synchronous motor characteristics are presented on the basis of cylindrical motor and two reaction theories. Armature winding, voltage and mmf waves, armature reaction, load saturation curves, regulation, and losses are emphasized. Parallel operation, frequency changers, and synchronous converters are presented. Many problems and laboratory work supplement the basic theory.

Text: AC Machinery, Bryant and Johnson.

Prerequisites: EE-471.

EE-473 SYNCHROS 2-2

This course presents a thorough treatment of the basic theory of synchros and synchro systems for curricula requiring preparation for further advanced study. The mathematical analysis of single phase and polyphase synchro systems covers voltage, current, and torque relations for normal and fault conditions, vector diagrams, and equivalent circuits. Problems and laboratory work supplement the theory. The course is presented in lecture form. No suitable text is available.

Prerequisites: EE-272.

EE-551 TRANSMISSION LINES AND FILTERS 3-2

This course presents the essential basic principles of transmission lines and filters. The topics covered are transmission line parameters, infinite line, open and shorted lines, reflection, matching, stubs, T and Pi sections, constant K and M derived sections, and composite filters. Problems and laboratory work are included..

Text: Communication Circuits, Ware and Reed.

Prerequisites: EE-251.

EE-571 TRANSMISSION LINES AND FILTERS 3-4

This course presents a thorough coverage of the basic theory of transmission lines and filters for the curricula requiring preparation for further advanced work. The topics covered in detail are transmission line parameters, infinite line, open and shorted lines, reflection, transmission line efficency, impedance transformation, stubs, T and Pi sections, constant K and M derived sections, and composite filters. Problems and laboratory work supplement the theory.

Text: Communication Circuits, Ware and Reed.

Prerequisites: EE-272.

EE-651 TRANSIENTS AND SERVOS 3-4

This course presents the essential basic principles of electrical transients and servo-mechanisms. The topics covered are DC and AC transients in series, parallel, series-parallel, and coupled circuits using the methods of differential equations and Heaviside. The La Place transform method is introduced. An analysis is given of servo-mechanisms with viscous damping and differential and integral control, using the transfer function method. Problems and laboratory experiments illustrate the theory.

Texts: Transients in Linear Systems, Gardner and Barnes: Servomechanism Fundamentals, Lauer, Lesnick and Matson.

Prerequisites: EE-451.

EE-655 FILTERS AND TRANSIENTS 3-2

This course presents the essential basic principles of filters and electrical transients. For filters the topics covered are T and Pi sections, and composite filters. In transients the topics include DC and AC transients in series, parallel, series parallel, and coupled circuits, using the method is introduced. Problems are assigned.

Texts: AC Circuits, Kerchner and Corcoran: Introduction to Electric Transients, Kurtz and Corcoran.

Prerequisites: EE-251.

EE-671 TRANSIENTS 3-4

This course presents in a very thorough way the basic theory of electrical transients in networks for the curricula requiring preparation for further advanced study. The topics covered are DC and AC transients in series, parallel, series parallel, and coupled circuits for particular boundary conditions using the methods of differential equations. Heaviside, Fourier, and La Place. Non-linear constants the forcing functions other than DC and AC are included. Many problems illustrate the basic theory and the methods of analysis.

Texts: Transients in Linear Systems, Gardner and Barnes: Introduction to Electric Transients, Kurtz and Corcoran.

Prerequisites: EE-251 or EE-272.

EE-672 SERVO-MECHANISMS 3-4

This course presents a thorough treatment of the basic theory of servo-mechanisms for curricula requiring further advanced study. In this course the topics covered are elementary forms of control systems, servo system follow-up links, analysis of servo-mechanisms with viscous damping, error rate damping, integral control, transfer function and db-log frequency analysis methods, error rate stabilization networks, typical design calculations, and general considerations. Problems and laboratory work illustrate the theory and the methods of analysis.

Text: Principles of Servomechanisms, Brown and Campbell.

Prerequisites: EE-671; EE-452 or EE-473.

EE-711 ELECTRONICS 3-2

This course treats of the fundamental theory of the electron, gaseous conduction, thermionic emission, and electron tube characteristics. The principles of the amplifier, rectifier, and oscillator circuits are presented in their essentials. Some consideration is given to the special tubes encountered in electronic devices. Laboratory work serves to integrate the principles presented in the classroom with practical applications and circuits.

Text: Engineering Electronics, Fink.

Prerequisites: EE-214.

EE-731 POWER ELECTRONICS 3-2

This course presents the theory of electronics and synchro instruments, and a study of their applications to naval devices. The theory and applications of the various types of electron tubes is covered. Emphasis is placed upon the thyratron tube. Also the theory of the selsyn instrument and its use is included. The laboratory work consists of experiments that demonstrate the characteristics and applications of tubes and selsyns. Remote control is illustrated with laboratory models.

Text: Electronics for Industry, Bendz.

Prerequisites: EE-231.

EE-751 ELECTRONICS 3-4

This course treats of electron tube characteristics and the basic circuits in which tubes are used. The theory and application of vacuum tubes and gas tubes are covered including such special tubes as the ignitron, cathode ray tube, and phototube. The basic theory of rectifier and amplifier circuits is developed and illustrated in actual commercial applications. Problems and laboratory work are designed to supplement the classroom presentation.

Text: Electronics, Millman and Seely.

Prerequisites: EE-451.

EE-753 ELECTRONICS 1-2

This course presents the operating principles of industrial electronic power and control circuits with particular attention to the application of gas and vapor tubes. The fundamentals of amplifiers and oscillators is covered as necessary for the understanding of control circuits in many commercial devices. Laboratory and problem work illustrate the basic facts.

Text: Electronics, Millman and Seely.

Prerequisites: EE-451.

EE-755 ELECTRONIC CONTROL AND MEASUREMENT 3-4

This course presents the principles and practice of electronic control and measurement as used in research laboratories and in industry. It includes the theory of basic circuits such as vacuum tube voltmeters, bridges, direct coupled amplifiers, timing circuits and frequency sensitive circuits with particular attention to their application in industrial instruments for the measurement and control of current, voltage, frequency, illuminators, spped, pressure, and temperature.

Texts: The Electronic Control Handbook, Batcher and Moulic: Applied Electronics, M.I.T. staff.

Prerequisites: EE-751.

EE-771 ELECTRONICS 3-2

This course consists of a thorough presentation of the theory of electron tubes and circuits in which they are used for those curricula requiring preparation for further advanced work. It includes the theory of electron motion in electric or magnetic fields, vacuum and gas tube characteristics, and the principles of special tubes such as the ignitron, glow tube, cathode ray tube, and phototube. Circuit theory of rectifiers, detectors, amplifiers, and oscillators is covered with particular attention to industrial power and control applications. Laboratory experiments and problems supplement the basic theory.

Text: Applied Electronics, M.I.T. staff.

Prerequisites: EE-272.

EE-772 ELECTRONICS 3-2

This course is a continuation of EE-771. It presents in detail the more complicated electronic circuits encountered in practice with particular attention to the integration of various components in accordance with basic theory of stabilization and feedback.

Text: Applied Electronics, M.I.T. staff.

Prerequisites: EE-771.

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EE-871 ELECTRICAL MACHINE DESIGN 4-0

This course presents a thorough quantitative analysis of machine characteristics using the design approach. It serves to develop an appreciation for the limitations and possibilities in electrical machine construction especially for naval applications, and the ability to evaluate properly the merits of present designs. In particular, this course consists of the quantitative study and design of a transformer to meet certain specifications. Later, the analysis of the DC machine is begun.

Text: Principles underlying the Design of Electrical Machinery, Slichter.

Prerequisites: EE-472.

EE-872 ELECTRICAL MACHINE DESIGN 4-0

This course is a continuation of EE-871. It consists of the completion of the quantitative analysis and design of a DC machine and the beginning of a similar analysis of the synchronous machine.

Text: Principles Underlying the Design of Electrical Machinery, Slichter.

Prerequisites: EE-871.

EE-873 ELECTRICAL MACHINE DESIGN 4-0

This course is a continuation of EE-872. It consists of the completion of the quantitative analysis and design of a synchronous machine and a similar analysis and design of the induction machine.

Text: Principles Underlying the Design of Electrical Machinery, Slichter.

Prerequisites: EE-872.

EE-971 SEMINAR 1-0

In the seminar sessions papers on research and developments in the field of electrical science are presented to the more advanced groups of students. Some appreciation for research methods is developed. In these sessions papers treating of research in progress and matters of major importance in electrical engineering are delivered by the faculty and by the students pursuing an advanced engineering curriculum.

Prerequisites: A background of advanced work in electrical engineering deemed adequate.

EE-972 THESIS

This work provides an opportunity for research and study necessary for the preparation of the thesis as required for the Master's Degree in Electrical Engineering. Individual laboratory and library work is performed under the general supervision of the members of the electrical engineering staff.

Prerequisites: The first two years of the advanced electrical engineering curriculum.

ELECTRONICS ENGINEERING

Es Courses

Electronics Administration	Es-036
Electricity	Es-111
Electricity	Es-112
Circuit Analysis and Measurement	Es-113
Circuit Analysis and Measurement	Es-114
Advanced Circuit Theory	Es-121
Advanced Circuit Theory	Es-122
Radio Frequency Measurements	Es-126
Advanced Circuit Theory	Es-133
Advanced Circuit Theory	Es-134
Communications Fundamentals	Es-186
Electron Tubes	Es-211
Electron Tubes	Es-212
Electron Tubes	Es-213
Electron Tubes	Es-214
Electron Tubes	Es-225
Ultra-High Frequency Tubes	Es-226
Introduction to Radar Applications of Vacuum Tubes	Es-256
Electron Tubes and Circuits	Es-261
Electron Tubes and Circuits	Es-262
Electronic Fundamentals	Es-281
Vacuum Tube Circuits	Es-282
Pulsing and High-Frequency Circuits	Es-286
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Radio Systems	Es-322
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Radar	Es-431
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Introduction to Radar	Es-441
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Special Systems	Es-531
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Electromagnetics	Es-621
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Electromagnetics	Es-623
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Antennas, Transmission Lines, and Wave Guides	Es-736
R.F. Energy Transmission	Es-786
Thesis	Es-831
Thesis	Es-832
Project Seminar	Es-836
Introduction to Electronics	Es-991
Introduction to Electronics	Es-992

Es-036 ELECTRONICS ADMINISTRATION 2-0

A problem and lecture series designed to acquaint the student with the administration and organization of electronics activities and applications, ashore and afloat. Army, Navy and Air Force organization; Shipyard electronics organization; radio station administration; electronics supply matters are among the topics covered.

Prerequisites: None.

Es-111 D.C. ELECTRICITY 4-4

This course is laid out to develop a sound conception of electromotive force, potential, resistance, current; a facility in the use of such basic principles as Ohm's law, Kirchhoff's laws, series, parallel, and series-parallel circuits; the theory and use of D-C instruments and bridges, the magnetic circuit, and a simple treatment of D-C transients in RL and RC circuits.

The laboratory is designed, by the inclusion of simple experiments, to make clear the fundamental concepts studied in class. One of its primary aims is to acquaint the students with typical circuit components and basic measuring devices and their proper use.

Text: Fundamentals of Electrical Engineering, Hessler & Carey

Es-112 A.C. ELECTRICITY 4-4

Alternating current principles are introduced; sound conceptions of steady state circuit analysis are developed; reactance, impedance, admittance, conductance, susceptance, network theorems, series and parallel circuits, complex notation, non-sinusoidal waves, resonant circuits, and elementary three phase circuit theory.

Laboratory exercises illustrate principles and introduce measurement instruments.

Text: Alternating Current Circuit Theory, Reed

Prerequisites: Es-111.

Es-113 CIRCUIT ANALYSIS & MEASUREMENTS 3-3

This course is designed to develop the fundamentals and to provide drill in elementary radio circuit analysis. In addition the student is introduced to the techniques of measurements at radio frequencies. The topics included are: coupled circuits, network theorems, the infinite line, radio frequency bridges, measurements involving complex wave forms in high impedance, high frequency circuits.

Texts: Communication Engineering, Everitt: Radio Engineering, Terman: Measurements in Radio Engineering, Terman.

Prerequisite: Es-112

Es-114 CIRCUIT ANALYSIS & MEASUREMENTS 3-3

This course is a continuation of Es-113. The topics included are: reflections in lines, the solution of the general line, stubs, derivation and use of circle diagrams, constant K and m-defived filters, impedance transformations, the use of slotted lines in impedance measurements.

Prerequisite: Es-113.

Es-121 ADVANCED CIRCUIT THEORY 3-2

Introduction to transient phenomena in electrical networks and their solutions on the loop and nodal basis; modes. Solutions are by classical methods, faurier Integral, LaPlace transforms.

Text: Communication Networks, Vol. I; Guillemin: Frequency Analysis, Modulation, and Noise; Goldman: Transients in Linear Systems; Gardner and Barnes.

Prerequisite: Es-114

Es-122 ADVANCED CIRCUIT THEORY 3-2

The Laplace transform is employed for solution of transients in typical circuits used in radio and radar.

Text: Transients in Linear Systems; Gardner and Barnes.

Prerequisite: Es-121.

Es-126 RADIO FREQUENCY MEASUREMENTS 2-6

This course is desgined to study the techniques of the measurement of voltage, current, power, impedance and frequency bridges in the various frequency ranges. The topics include a detailed study of radio frequency, resonant methods, precision slotted lines, microwave measurements, standards of E.R.L.C and F.

Text: Radio Frequency Measurements, Hartshorn.

Prerequisites: Es-114, Es-225

Es-133 ADVANCED CIRCUIT THEORY 3-0

The transmission line as a communication facility leading to filter theory is treated. Particular topics are, Four Terminal Networks, Foster's reactance theorem with Cauer's extension, Lagrange's equations; driving point impedance, principle of duality, lumped loaded lines, lattice structures.

Text: Communication Networks, Vol. II, Guillemin.

Prerequisite: Es-122

Es-134 ADVANCED CIRCUIT THEORY 3-0

The theory and basic design of ladder and lattice structure filters are studied together with their transient behavior.

Text: Communication Networks, Vol. II; Guillemin: Network Analysis and Feedback Amplifiers; Bode.

Prerequisite: Es-133.

Es-186 COMMUNICATIONS FUNDAMENTALS 4-4

Course contents cover the fundamental principles of radio communications and basic circuits. Included topics are: Fundamentals of energy transmission by means of radio waves; basic alternating current theory; frequency selectivity circuits; coupled circuits.

Text: Radio Engineering, Terman.

Es-211 ELECTRON TUBES AND CIRCUITS 2-3

This course gives an elementary treatment of thermionic emission, space charge, diodes, triodes, tetrodes, pentodes, cathode-ray tubes, oscilloscope, gas tubes, thyratrous, rectifiers, power filters and regulated power supplies.

Text: Electronic Circuits and Tubes; Cruft.

Prerequisite: None.

Es-212 ELECTRON TUBES AND CIRCUITS 2-3

This course emphasises the use of the vacuum tube as a switch. Topics are timing, sweep and pulse circuits; audio voltage amplifier, square-wave generator, clippers, clampers, differentiators, integrators, switching, keying, trigger circuits, multivibrators, and oscilloscope circuits.

Text: Electronic Circuits and Tubes; Cruft: Radar Electronic Fundamentals; Navships 900,016.

Prerequisite: Es-211.

Es-213 ELECTRON TUBES AND CIRCUITS 4-3

This course covers power amplifiers, video and transformer-coupled voltage amplifiers, phase inverters, cathode follower, inverse feedback, R-F, I-F, and wide-band tuned amplifiers, feedback oscillators.

Text: Electronic Circuits and Tubes; Cruft: Applied Electronics - MIT: Radio Engineering: Terman.

Prerequisite: Es-212.

Es-214 ELECTRON TUBES AND CIRCUITS 4-3

This course continues with crystal oscillators, B-F, R-C, and relaxation oscillators; A-M, F-M, and P-M methods of modulation; diode, square-law, grid, and plate detection; AVC, infinite impedance detector, discriminators; receiver principles; polyphase and controlled rectifiers; theory of electrons in metals, emission, semi-conductors, etc.

Text: Electronic Circuits and Tubes; Cruft: Electronics; Millman and Seely.

Prerequisite: Es-213.

Es-225 ELECTRON TUBES 3-6

This course covers noise, electron ballistics, electron optics, cathode-ray tubes, photomultiplier tubes, television tubes; limitations of conventional tubes at ultra-high frequency and transit time effects.
Text: Vacuum Tubes; Spangenberg.

Prerequisite: Es-214

Es-226 ULTRA-HIGH-FREQUENCY TUBES 4-3

This course covers cavity resonators, klystron and magnetron tubes and circuits, traveling-wave tubes, pulsing circuits, and related laboratory work.
Text: Vacuum Tubes; Spangenberg: Radar System Engineering; Ridenour: Principles of Radar; MIT.

Prerequisites: Es-225, Es-623.

Ex-256 INTRODUCTION TO RADAR APPLICATIONS OF VACUUM TUBES 2-0

The use of a tube as a switch, Clipping device, Multivibrators, Sawtooth Generators, Simple R-C Transient circuits.
Text: Radar Electronic Fundementals; Navships 900,016.

Es-261 ELECTRON TUBES AND CIRCUITS 3-2

The first term of a two-term course in the fundamentals and general applications of electron tubes and circuits, primarily for non-communication students. Includes emmission, characteristics of vacuum and gas tubes, rectifiers and filters, grid-controlled rectifiers, class A amplifiers.
Text: Applied Electronics; M.I.T.

Prerequisites: Es-111, Es-112.

Es-262 ELECTRON TUBES AND CIRCUITS 3-2

Continuation of Es-261. Includes feedback amplifiers, class B and C amplifiers, oscillators, modulation and detection.
Text: Applied Electronics, M.I.T.

Prerequisites: Es-261.

Es-281 ELECTRONIC FUNDAMENTALS 2-2

Course contents cover the basic principles of electronics. Included topics are: Review of basic mathematical concepts; The underlying physical principles of electron tube operation; Characteristics of electron tube operation.
Text: Physics; Robeson: Fundamentals of Vacuum Tubes; Eastman: Mathematics for Electricians & Radiomen; Cooke.

Prerequisite: None.

Es-282 VACUUM TUBE CIRCUITS 4-4

Course contents cover the operational characteristics of electron tubes and some of their applications. Included topics are: general operations1 features of diodes, triodes, multigrid tubes and gas tubes; amplification of small alternating voltages; power amplifiers.

Text: Fundamentals of Vacuum Tubes; Eastman; Radio Engineering; Terman.

Prerequisite: Es-281.

Es-283 VACUUM TUBE CIRCUITS 4-4

Course contents cover further applications of electron tubes, in continuation of the course material presented in Es-282. Included topics are: Sine wave oscillators; Amplitude modulation and the A-M transmitter; Demodulation and the TRF receiver; Frequency translation and the superheterodyne A-M receiver; power supplies; Frequency modulation.

Text: Fundamentals of Vacuum Tubes; Eastmen: Radio Engineering; Terman.

Prerequisite: Es-282.

Es-286 PULSING AND HIGH-FREQUENCY CIRCUITS 2-4

Course contents cover the principles and underlying problems of pulsing and high-frequency circuit operation. Included topics are: Characteristics of nonsimusoidal waves; Pulse-shaping techniques; The sawtooth generator, multivibrator, and blocking oscillator; Problems and techniques of high-frequency circuit operation; the magnetron and velocity-modulated tubes.

Text: Radar Electronic Fundamentals; Navships 900,016: Principles of Radar; MIT staff.

Prerequisite: Es-282.

Es-321 RADIO SYSTEMS 3-3

This course is the first of a sequence of five on the engineering applications of theoretical electronics to the specific problems of radio communications and electronic systems. These courses are designed to give the student experience in design as well as to integrate his previous theoretical training as applied in radio systems engineering.

The course starts with a survey of the basic problems of a general communications system with emphasis on systems involving telegraph and telephone. these basic principles are then applied to radio communications proper, with an examination of the characteristics of the transmitting medium and natural division of the types of communications for different frequency bands.

The remainder of the course is devoted to the design of transmitters for high and medium frequencies. Oscillators, stability and flexibility of master oscillators, crystal oscillators, frequency synthesis generators, buffer amplifiers and multipliers, Class C power amplifiers, band switching circuits, output coupling circuits, speech amplifier circuits, modulators, speech clipping and AMC circuits, power supply circuits, protective circuits, and remote control circuits.

Text: Radio Engineer's Handbook, Terman: War Department Technical Manual, TM11-486 (Electrical Communication System Engineering : Navy Equipment Instruction Books).

Prerequisites: Es-225.

Es-322 RADIO SYSTEMS 3-3

This is a continuation of the series begun in Es-321. The course begins with the design of receivers for the receiption of amplitude modulated signals in the high and medium frequency bands. Antenna coupling circuits, R-F amplifiers, oscillators, mixers, tracking problems, I-F amplifiers, crystal filters, detectors, noise limiters, silencers, audio amplifiers, audio filters, noise characteristics, receiver standards and testing, the operation of receivers and transmitters in communication practice, mutual interference and cross talk, and spurious responses.

The design problem is extended to include the VHF region and the changes introduced by the use of frequency and phase modulation.

Texts: Radio Receiver Disign, Sturley; Radio Engineer's Handbook, Terman; Microwave Receivers, MIT RadLab; and other selected references.

Prerequisites: Es-321.

Es-333 RADIO SYSTEMS 3-3

This course continues the systems series. The application of teletype and frequency shift-keying to radio transmission begins the study of the design of frequency shift transmitters and receivers. The basic principles of multiplexing teletype and telegraph signals with voice channel audio tones, applications of multiplexing to shore station remote control equipment, single side band transmission theory and basic single sideband multiplex transmitter and receiver design and included.

Text: Naval Instruction Books, Instructor's Notes.

Prerequisites: Es-322.

Es-386 TRANSMITTERS AND RECEIVERS 3-3

Course contents cover the operational characteristics of typical Navy type transmitters and receivers. Included topics are Frequency standards and meters; Navy transmitters; Navy receivers.

Text: Lecture Notes & Equipment Instruction Books.

Prerequisites: Es-283, Es-786.

Es-431 RADAR SYSTEM ENGINEERING 3-3

Fundamental principles of radar. Theory of operation and design features of radar timing circuits, indicators, modulators, transmitters, RF systems and receivers. Related laboratory work given concurrently.

Text: Radar System Engineering and M.I.T.; Ridenour; Principles of Radar; Radar School Staff.

Prerequisites: Es-226.

Es-432 RADAR SYSTEM ENGINEERING 3-6

Study of representative search, firecontrol, and IFF systems, including airborne, with particular attention to design features. Study of current radar developments. Related laboratory work on current Navy radar equipment.
Text: Radar System Engineering; Ridenour.

Prerequisites: Es-431.

Es-446 INTRODUCTION TO RADAR 2-2

A study of the radar range equation, i.e. Effect of pulse duration, pulse repetition frequency, Types of targets, etc. Block diagram studies of current fire-control systems, with emphasis on operational limitations, propagation phenomena, types of presentation, and antijam techniques. Laboratory work to emphasize operationsl techniques of current fire-control systems.
Text: Principles of Radar, M.I.T. Radar School Staff.

Prerequisite: None.

Es-456 INTRODUCTION TO RADAR (AIRBORNE) 2-2

A study of the radar range equation, i.e. Effect of pulse duration, pulse repetition frequency, types of targets, etc. Block diagram studies of current Airborne systems with emphasis on operational limitations, propagation phenomena, types of presentation, and anti-jam techniques. Laboratory on current airborne radar equipment.
Text: Principles of Radar; M.I.T. Radar School Staff.

Prerequisite: None.

Es-531 SPECIAL SYSTEMS 3-3

A continuation of the series starting with Es-321. Pulse modulation principles, pulse time modulation multiplex, principles of television, television receiver and transmitter design, facsimile, and basic telemetering systems.
Text: Naval Instruction Books, Instructor's Notes.

Prerequisites: Es-333.

Es-532 SPECIAL SYSTEMS 3-3

A continuation of the special systems series. Principles of radio navigation and radio and radar counter measures. An analytical treatment of the directive properties of loop antennas, circuit analysis of typical radio compasses, analysis of direction finder errors, the fundamentals of Loran systems, and the element by element analysis of the circuits used in typical counter measures systems.
Text: Very High Frequency Techniques, Vol. I; Loran, MIT RadLab; and other selected references.

Prerequisites: Es-531.

Es-586 SPECIAL SYSTEMS 3-3

Course contents cover Navy electronic systems other than communications transmitters and receivers. Included topics are: Loran systems; Radar systems; Image transmission systems; Frequency-shift keying techniques; Multiplex systems.

Text: Lecture Notes and Equipment Instruction Books.

Es-621 ELECTROMAGNETICS 3-0

An introduction to the fundamental definitions and circuit parameters later to be used in resonant cavities, wave guides, wave propagation, etc., as exemplified through the differential equations solution of lump circuits and transmission lines. An application of vector analysis to electrostatics and magnetostatics in rectangular and in generalized coordinates, including the gradient, divergence, and curl of electromagnetic fields; scalor and vector potentials; energy stored in electric and in magnetic fields. Text material is considerably amplified in class lectures.

Texts: Fields and Waves in Modern Radio; Ramo and Whinnery.

References: Principles of Electricity and Electromagnetism; Harwell: Electromagnetic Theory; Stratton: Electromagnetic Waves; Schelkunoff:

Prerequisite: Ma-124.

Es-622 ELECTROMAGNETICS 4-0

A continuation of Es-621. An application of complex variables to potential theory; derivation of capacitance and inductance per unit length for open wire and co-oxial transmission lines; application of Bessel equations to potential theory; Maxwell's equations; relations between units; Poisson's equations; retarded vector potentials; radiation from current dipole, half-wave antennas; radiation resistance of half-wave antennas in terms of Ci and Si functions; antenna arrays; field patterns and gain of yagi arrays; imput impedance of yagi arrays.

Text: Same as Es-621.

Prerequisite: Es-621.

Es-623 ELECTROMAGNETICS 4-0

A continuation of Es-622. Skin effect and internal impedance, solutions involving Bessel and Hankel functions; calculation of inductance. Propagation and reflection of plane electromagnetic waves; attenuation; power factor; waves guided by lossy planes; solutions of Maxwell's equations for rectangular and cylindrical wave guides.

Text: Same as Es-621.

Prerequisite: Es-622.

Es-624 ELECTROMAGNETICS 3-0

A continuation of Es-623. Radial disk transmission lines; resonant cavities; generalized Maxwell's equations; generalized method of deriving radiation field patterns; radiation resistance; long straight wire antenna; Vee antenna radiation from end of wave guide; rhombic antenna; non-uniform transmission line; input impedance of antennas.

Text: Same as Es-623.

Prerequisite: Es-623

Es-736 ANTENNAS, TRANSMISSION LINES 3-3

This course presents the engineering problems associated with the practical design of antennas, antenna systems, and transmission lines. A technique of rapid approximation of antenna field patterns is presented. All of common receiving and transmitting antennas are presented and analyzed. The problems inherent in the various frequency ranges are discussed including the microwave region. The problem of efficient transmission of R.F. energy, matching, phasing and achieving proper current distributions are studied. The classwork is accompanied by considerable problem drill and measurements on typical systems.

Prerequisite: Es-624.

Es-786 R-F ENERGY TRANSMISSION 4-2

Course contents cover the principles and techniques of energy transmission by means of radio-frequency waves. Included topics are: Conditions for maximum energy transfer between circuits; R-F transmission lines for energy transfer; Lines as circuit elements; Principles of energy radiation; Directional radiation techniques; propagation characteristics; Guided waves.

Texts: Radio Engineering; Terman: Radar Electronic Fundamentals; 900, 016.

Prerequisite: Es-186.

Es-831 THESIS 2-0

This course provides the student with the opportunity for study and research in connection with the preparation of the thesis as required in Electronics Curriculum. Few formal classes are scheduled, instead the student is concerned with the choice of a suitable topic and does the necessary preliminary library and laboratory work. Staff members are consulted as the work progresses.

Es-832 THESIS 4-0

This course continues and completes the preparation of the thesis begun in Es-831.

Es-836 PROJECT SEMINAR 1-0

This course provides the student with the opportunity to prepare a report on the project in which he was engaged during his experience at an industrial laboratory. The student is required to give an oral seminar report.

Es-991 and 992 INTRODUCTION TO ELECTRONICS 2-0

This course will continue through two consecutive terms and is intended to acquaint the student officer with the general principles, capabilities and limitations of radio, sonar and radar and to give him a limited familiarity with equipment. The following topics will be studied in an elementary manner: Resonant circuits, Principles of vacuum tubes, Their actions as oscillation, amplifier, detector, modulation, general principles of transmitters and receivers, both AM and FM, Antennas, wave propagation, basic principles of radar and sonar.

Prerequisites: None

GEOLOGY

Ge Courses

Geology, Physical	Ge-101
Geology of Petroleum	Ge-241
Minerology, Determinative	Ge-302
Petrology	Ge-401

Ge-101 PHYSICAL GEOLOGY 3-0

The course initiates the student into the study of the various geological phenomena. Among the principle topics discussed are: rock-forming minerals; igneous, sedimentary, and metamorphic rocks; weathering and erosion; stream sculpture; glaciation; surface and sub-surface waters; volcanism; dynamic processes; and structural geology.

Frequent reference is made to other than the presceibed textbook. The course is given as much as possible to stress those topics of particular interest to the petroleum engineer.

Text: Physical Geology; Longwell, Flint, Knopf.

Prerequisites: None.

Ge-241 GEOLOGY OF PETROLEUM 2-2

The course includes discussions on the origin, accumulation, and structure which aid in the accumulation of petroleum, its general occurence and distribution. The important oil fields of the world are then taken up in detail as to the occurrence and associated structures in particular fields. The following regions are studied: Eastern United States, Mid-Continent, Gulf Coast, Rocky Mountains, Pacific Coast, North America (except U.S.), West Indies, South America, Europe, Russia, Oceana and Asis. This course is supplemented by reading assignments in the current petroleum and petroleum geology journals.

Text: Geology of Petroleum; Emmons.

Prerequisite: Ge-101.

Ge-302 DETERMINATIVE MINERALOGY. 1-4

The lectures are designed to familiarize the student with the principles and technique involved in determining minerals in the laboratory. The laboratory periods are spent in the determination of some fifty of the more common minerals by blowpipe, chemical, x-ray diffraction, and crystallographic methods. The student is also made familiar with the methods employed in the use of chemical microscopy for the determination of certain elements.

Text: Determinative Mineralogy; Lewis, Hawkins.

Prerequisite: Cr-301.

Ge-401 PETROLOGY AND PETROGRAPHY 3-4

The course consists of a series of lectures on the differentiation of magmas into the various igneous rock series on the basis of physical chemical theories; the characteristics, structures and textures of igneous rocks; the sedimentary rocks, their origin and types with particular emphasis on the oil-bearing rocks; the metamorphic rocks, mineral alteration, metamorphism and the resultant rock types.

The laboratory work consists of the study of the various rocks in hand speciments, and in thin sections under the petrographic microscope.

When practicable, the course is supplemented by trips to nearby localities to study rocks and minerals in the field.

Text: Petrography and Petrology; Grout.

Prerequisites: Ge-101, Cr-301.

INDUSTRIAL ENGINEERING

IE Lecture Courses

Principles of Industrial Organization I	IE-101
Principles of Industrial Organization II	IE-102
Applied Industrial Organization	IE-103
Psychophysical Systems Research	IE-104

IE-101 PRINCIPLES OF INDUSTRIAL ORGANIZATION (Lecture Course) 0-1

The course is a study of the origin and growth of industrial enterprises, principles of organization, control and production, systems research, standards and standardization, industrial relations, and the effects of science upon industry. This course is presented in a series of ten lectures, given by an authority in the field of Management Engineering, covering the material listed above.

Text: None

Prerequisites: None.

IE-102 PRINCIPLES OF INDUSTRIAL ORGANIZATION 0-1
(Lecture and Reading Course)

This course is a study of the origin and growth of industrial enterprises, principles of organization, control of production, systems research, standards and standardization, industrial relations, and the effects of science on industry. This course is presented in a series of ten lectures, given by an authority in the field of Management Engineering, covering the material listed above. Assignments in the text are covered, prior to each lecture, by the students without formal classroom instruction. A final examination is given on the combined material obtained from lectures and text.

Text: Principles of Industrial Organization; Kimball and Kimball.

Prerequisites: None.

IE-103 APPLIED INDUSTRIAL ORGANIZATION (Lecture Course) 0-1

This course is a study of the application of the principles of Industrial Organization to the structure of industrial enterprises. In a series of ten lectures, given by representatives of major industries, an overall pricture of the structure of major industrial organizations is presented. The pattern followed is a delineation of the broad aspects of a large organization followed by explanation of the functions of the lower echelons of the organization.

Text: None.

Prerequisite: IE-101 or IE-102.

IE-104 PSYCHOPHYSICAL SYSTEMS RESEARCH (Lecture Course) 0-1

This course is a series of five lectures given by authorities in the field of Psychophysical Systems Research covering the background of research in human engineering; quantitative methods employed in psychophysical research and tests; optimum physical conditions of operation of instruments; problems of equipment design; basic research in the design of the instruments; the design of tasks; the working environment; the appraisal and design of systems.

Text: None.

Prerequisites: None.

FOREIGN LANGUAGE

La Courses

German	La-101
German	La-102
German	La-103
German	La-104
German	La-105
German	La-106
German	La-107
German	La-108
Russian	La-201
Russian	La-202
Russian	La-203
Russian	La-204
Russian	La-205
Russian	La-206
Russian	La-207
Russian	La-208

La-101 GERMAN 2-0

This course will include study of grammar, sufficient for reading intelligently scientific works in German, use of dictionaries, and practice in translating from German to English. The main emphasis will be placed on the acquisition of a large, technical reading-vocabulary.

Texts: Shorter College German; Evans, Roseler: Reading German; Morgan, Strothmann: New German Dictionary; Heath.

Prerequisite: None.

La-102, La-103, La-104,
La-105, La-106, La-107 and La-108 GERMAN 2-0

These courses are progressive continuations of the course La-101, and follow one another in the order given. Each course is given in a separate term; is an advancement over the preceding course; and leads to the ability to read technical German publications in Meteorology.

Text: An Authology of Scientific German; Wilde.

Prerequisite: La-101 or the preceding listed La-course.

La-201 RUSSIAN 2-0

This course will include study of necessary grammatical constructions for reading, use of dictionaries, and practice in translating maderial from Russian to English. Chief emphasis will be placed on the acquisition of a large, technical reading-vocabulary.

Texts: Selections from: Estestvoznznie, Teturev; Geografia, Terchova and Evdeli; Fizichekaya Geografia, Barkov and Polovinkin: Collognial Russian; Sieff: Russian-English Dictionary; Muller.

Prerequisite: None.

La-202, La-203, La-204,
La-205, La-206, La-208. RUSSIAN 2-0

These courses are progressive continuations of course La-201, and follow one another in the order given. Each course is given in a separate term; is an advancement over the preceding course; and leads to the ability to read Russian publications in Meteorology.

Texts: As selected.

Prerequisite: La-201 or the preceding listed La-course.

Ma Courses

Ordinary Differential Equations	Ma-101
Series and Vector Algebra	Ma-102
Functions of Several Variables and Vector Analysis	Ma-103
Partial Differential Equations and Related Topics	Ma-104
Fourier Series and Boundary Value Problems	Ma-105
Complex Variable and Laplace Transform	Ma-106
Orthogonal Functions and Integral Equations	Ma-107
Vector Mechanics and Numerical Methods	Ma-134
Partial Differential Equations and Introduction to Statistics	Ma-135
Selected Advanced Topics	Ma-155
Algebra, Trigonometry, and Analytic Geometry	Ma-161
Introduction to Calculus	Ma-162
Ordinary Differential Equations	Ma-171
Differential Equations and Infinite Series	Ma-172
Functions of Several Variables and Vector Analysis	Ma-173
Laplace Transforms, Partial Differential Equations, and Complex Variables	Ma-174
Partial Derivatives and Ordinary Differential Equations	Ma-181
Vector Analysis	Ma-182
Complex Variables	Ma-183
Special Mathematical Methods of Physics	Ma-184
Graphical and Mechanical Computation	Ma-201
Graphical and Mechanical Computation	Ma-251
Statistics	Ma-301
Statistics	Ma-331
Statistics I	Ma-351
Statistics II	Ma-352
Mathematical Computation by Mechanical Means	Ma-401
Mathematical Computation by Mechanical Means	Ma-451

Ma-101 ORDINARY DIFFERENTIAL EQUATIONS 5-0

First order differential equations; elementary operations with complex numbers; roots of algebraic equations by Newton's and Graeffe's methods; partial derivatives; ordinary differential equations including systems of linear differential equations with constant coefficients. Stability criteria.

Texts: Higher Mathematics; Sokolnikoff: Differential Equations (Revised); Cohen: Calculus; Granville, Smith, Longley.

Prerequisite: A special review course in differential and integral calculus, or the equivalent.

Ma-102 SERIES AND VECTOR ALGEBRA 5-0

Taylor series, power series, and operations on series. Introduction to elliptic integrals. Fourier series, Fourier transform, numerical harmonic analysis. Systems of linear equations, rank of a matrix, linear dependence. Vector algebra and solid analytic geometry of planes and lines.

Texts: Higher Mathematics; Sokolnikoff; Elementary Vector Analysis; Weatherburn: New Analytic Geometry; Smith, Gale, Neeley: Calculus; Granville, Smith, Longley.

Prerequisite: Ma-101.

Ma-103 FUNCTIONS OF SEVERAL VARIABLES AND VECTOR ANALYSIS 5-0

Analytic geometry of curves and surfaces and applications of partial derivatives. Differentiation of vectors and applications to kinematics. Vector differential operators. Line, surface and space integrals and applications to volumes, moments, potential and attraction. Divergence theorem and theroems of Green and of Stokes. Curvilinear coordinates. Introduction to analytic functions of a complex variable

Texts: Higher Mathematics; Sokolnikoff: Elementary and Advanced Vector Analysis; Weatherburn: New Analytic Geometry; Smith, Gale, Neeley: Calculus; Granville, Smith, Longley.

Prerequisite: Ma-102.

Ma-104 PARTIAL DIFFERENTIAL EQUATIONS AND RELATED TOPICS 5-0

Total differential equations and systems of ordinary differential equations. Linear and other first order and special cases of higher order partial differential equations with special emphasis on those having constant coefficients. Solution of ordinary differential equations in series; gamma, beta, Bessel and Legendre functions; Introduction to boundary value problems and orthogonal functions with applications to heat flow, vibrations of strings and membranes and flow of electricity in a cable. Interpolation formulas of Newton, Stirling and Lagrange, quadrature formulas and numerical integration of ordinary differential equations and systems.

Texts: Higher Mathematics; Sokolnikoff: Differential Equations (Revised); Cohen: Numerical Mathematical Analysis; Scarborough.

Prerequisite: Ma-103.

Ma-105 FOURIER SERIES AND BOUNDARY VALUE PROBLEMS 4-0

Derivation of some of the partial differential equations of applied mathematics, using vector and other methods. Study of Fourier series, Bessel and Legendre functions and other orthogonal functions. The Sturm-Liouville problem. Solution of boundary value problems by means of orthogonal functions. Uniqueness of the solution.

Texts: Fourier Series and Boundary Value Problems; Churchill: Mathematics of Physics and Chemistry; Margenau and Murphy.

Prerequisite: Ma-104.

Ma-106 COMPLEX VARIABLE AND LAPLACE TRANSFORM 4-0

Analytic functions; Cauchy's theorem, Laurent series, residues, contour integration, conformal mapping LaPlace transform and its use in solving ordinary differential equations; special theorems and manipulations for the Laplace transform; application to partial differential equations and difference equations.

Texts: Introduction to complex variables and Applications; Churchill: Modern Operational Mathematics in Engineering; Churchill: Transients in Linear Systems; Gardner and Barnes.

Prerequisite: Ma-104.

Ma-107 ORTHOGONAL FUNCTIONS AND INTEGRAL EQUATIONS 3-0

A study of orthogonal functions and of Sturm-Liouville and other eigenvalue problems, illustrated by Fourier series, Bessel functions, and the polynomials of Legendre, Hermite, Jacobi, and Laguerre; solution of integral equations by the methods of iteration, of Fredholm, and of Hilbert-Schmidt; applications.

Texts: Fourier Series and Boundary Value Problems; Churchill: Fourier Series and Orthogonal Polynomials; Jackson: Mathematics of Physics and Chemistry; Margenau and Murphy.

Prerequisite: Permission of Instructor.

Ma-134 VECTOR MECHANICS AND NUMERICAL METHODS 4-0

Vector equations of motion. Streamlines and trajectories. Irrotational, solenoidal and linear vector fields. Elementary differential geometry of surfaces. Numerical interpolation, differentiation and integration. Total differential equations and systems of linear differential equations.

Text: Advanced Vector Analysis; Weatherburn: Numerical Mathematical Analysis; Scarborough: Higher Mathematics; Sokolnikoff and Sokolnikoff.

Prerequisite: Ma-103.

Ma-135 PARTIAL DIFFERENTIAL EQUATIONS AND INTRODUCTION TO STATISTICS 4-0

Partial differential equations with applications to heat conduction and wave motion. Gamma, Beta and orthogonal functions. Boundary value problems. Curve fitting and the method of least squares. Preliminary considerations in the analysis of observational data. Fundamentals of probability. Bernouilli and Poisson distributions.

Texts: Differential Equations; Morris, Brown: Fourier Series and Boundary Value Problems; Churchill: Mathematics and Statistics; Kenney.

Prerequisite: Ma-134.

Ma-155 SELECTED ADVANCE TOPICS 3-0

Adjoint systems of ordinary linear differential equations; elliptic integrals; differentiation of integrals containing a parameter; quadratic forms in three or more variables; ellipsoid of inertia; extrema of functions of several variables; moving axial systems; angular velocity of a rigid body; elementary algebra of matrices.

Texts: Higher Mathematics; Sokolnikoff: Coordinate Geometry; Fine, Thompson.

Prerequisites: Ma-104, Mc-102.

Ma-161 ALGEBRA, TRIGONOMETRY AND ANALYTIC GEOMETRY 5-0

Review of elementary algebraic operations. Exponent laws and logatithms. Variables and functions of variables. Coordinate representation of functions -- graphs. The elementary trigonometric function. The straight line and its slope. Simultaneous linear equations. The quadratic equation. Elementary equations of the conics.

Text: A First Year of College Mathematics, Brink.

Prerequisite: None.

Ma-162 INTRODUCTION TO THE CALCULUS 5-0

The limit concept. The derivatives of elementary functions. Elementary applications of derivatives. Differentials, higher order derivatives and curvature. The integral as an antiderivative and as an area. Elementary applications of integration. Partial differentiation and total differential.

Text: Calculys, Sherwood and Taylor.

Prerequisite: Ma-161.

Ma-171 ORDINARY DIFFERENTIAL EQUATIONS 3-0

Hyperbolic functions; elementary operations with complex numbers. Roots of algebraic equations. Partial derivatives. Ordinary differential equations.

Texts: Higher Mathematics; Reddick, Miller: Calculus; Granville, Smith, Longley.

Prerequisite: Special review course in differential and integral calculus, or the equivalent.

Ma-172 DIFFERENTIAL EQUATIONS AND INFINITE SERIES 3-0

Systems of differential equations with constant coefficients. Applications of differential equations. Power series, Taylor series and operations on series. Solution of differential equations in series. Fourier series.
Texts: Higher Mathematics; Reddick, Miller

Prerequisite: Ma-171.

Ma-173 FUNCTIONS OF SEVERAL VARIABLES AND VECTOR ANALYSIS 3-0

Linear equations, determinants, linear dependence. Planes and lines, curves and surfaces. Vector algebra. Multiple and line integrals. Vector differential operators.
Texts: Higher Mathematics, Reddick and Miller: Vector Analysis, Phillips: Higher Mathematics, Sokolnikoff and Sokolnikoff.

Prerequisite: Ma-172.

Ma-174 LAPLACE TRANSFORMS, PARTIAL DIFFERENTIAL EQUATIONS, AND COMPLEX VARIABLES 3-0

Solution of ordinary differential equations and systems by the Laplace Transform method. Bessel functions. Solution of partial differential equations by Fourier series and Bessel functions. Analytic functions of a complex variable, conformal mapping, residues.
Texts: Higher Mathematics, Reddick and Miller: Modern Operational Mathematics, Churchill.

Prerequisite: Ma-173.

Ma-181 PARTIAL DERIVATIVES AND ORDINARY DIFFERENTIAL EQUATIONS 5-0

Partial and total derivatives; normal derivatives; differentials; implicit functions; line integrals; ordinary differential equations of the first order; linear differential equations of higher order. Physical applications.
Texts: Higher Mathematics; Burington, Torrance: Calculus; Granville, Smith, Longley.

Prerequisite: Special reveiw course in differential and integral calculus, or the equivalent.

Ma-182 VECTOR ANALYSIS 5-0

Vector algebra; derivatives of vectors; vector differential operators; differential equations associated with vector fields;double and triple integrals, surface integrals, integral relations of the Stokes-Gauss type. Physical Applications.
Texts: Elementary and Advanced Vector Analysis; Weatherburn.

Prerequisite: Ma-181.

Ma-182 VECTOR ANALYSIS 5-0

Vector algebra, derivatives of vectors, vector differential operators. Differential equations associated with vector fields. Double and triple integrals, surface integrals, integral relations of the Stokes-Gauss type. Physical applications.

Text: Elementary and Advanced Vector Analysis, Weatherburn.

Prerequisite: Ma-181.

Ma-184 SPECIAL MATHEMATICAL METHODS OF PHYSICS 5-0

Special functions of theoretical physics; calculus of variations; numerical methods; matrices; tensors. Physical applications.

Text: Mathematics of Physics and Chemistry; Margenau, Murphy.

Prerequisite: Ma-183.

Ma-201 GRAPHICAL AND MECHANICAL COMPUTATION 0-2

The course includes construction of uniform and non-uniform scales, systems of curves for equations in three variables, use of logarithmic and semi-logarithmic coordinate paper, construction of alignment charts and the theory and use of planimeters and integrators.

Text: Graphical and Mechanical Computation; Lipka.

Prerequisites: None.

Ma-251 GRAPHICAL AND MECHANICAL COMPUTATION 0-4

The course consists of twenty exercises each occupying one laboratory period. Two exercises are in the theory and use of the planimeter and integrator. The remaining exercises are devoted to the design of diagrams, including: construction of scales to show relations between two variables; construction of nomograms with families of lines or curves to show relations among three variables; alignment diagrams for three variables involving curved scales and curve nets; diagrams for more than three variables and diagrams with more than one index line; alignment diagrams with adjustment for equations in three or more variables; the Lafay-Wertheimer method for constructing a chart or alignment diagram from empirical curves.

Text: Design of Diagrams for Engineering Formulas; Hewes, Seward.

Prerequisites: None.

Ma-301 STATISTICS 3-2

Fundamental principles of probability. Probability distributions with special emphasis on the binomial, Poisson and normal distributions. (Regressions and correlation: simple and multiple. Distribution of mean, chi-square, variance, t and F. Analysis of variance. Tests of statistical hypotheses.)

Texts: Theory of Probability, Scheffe: Elementary Statistical Analysis; Wilks: Introduction to Mathematical Statistics, Hoel.

Prerequisite: Ma-103 (Can be taken concurrently.)

Ma-331 STATISTICS 4-2

Continuous frequency distributions. Moments and mathematical expectation. The normal and Type III Pearson distributions. Correlation: simple, multiple and partial. Non-linear regressions. Sampling theory and the testing of hypotheses. Applications to problems in aerology.

Text: Mathematics of Statistics; Kenney.

Prerequisite: Ma-135.

Ma-351 STATISTICS I 2-2

Fundamental principles of probability. Probability distributions with special emphasis on the hyperogeometric, binomial, Poisson and normal distributions. Distribution of sample mean.

Texts: Theory of Probability; Scheffe: Elementary Statistical Analysis; Wilks: Introduction to Mathematical Statistics; Hoel.

Prerequisite: Ma-155.

Ma-352 STATISTICS II 1-2

Regressions and correlation: simple and multiple. Distribution of correlation coefficient, chi-square, variance, t and F. Analysis of variance. Tests of statistical hypotheses. Introduction to quality control, sampling inspection programs and sequential analysis.

Texts: Elementary Statistical Analysis; Wilks: Introduction to Mathematical Statistics; Hoel: Economic Control of Quality of Manufactured Product; Shewhart: Sampling Inspection Tables; Dodge and Romig.

Prerequisite: Ma-351.

Ma-401 MATHEMATICAL COMPUTATION BY MECHANICAL MEANS 2-2

A wide variety of elementary devices which may be used to perform mathematical operations is considered together with instruments which combine them so as to solve problems largely without human intervention.

Texts: Theory of Mathematical Machines; Murray.

Prerequisite: Ma-103.

Ma-451 MATHEMATICAL COMPUTATION BY MECHANICAL MEANS 3-2

The theory and details of design of a wide variety of elementary and compound devices which may be used to perform mathematical operations mechanically are studied. Their relations to ordnance problems and equipment are considered. In as far as possible some of the subject material is presented to the class by the students in informal reports. Ten hours are devoted to further study of the material in numerical analysis presented in Ma-104 and to further topics in this field including Lozenge diagrams, symbolic methods, Euler's formula, Gauss's formula, cubature.

Texts: Theory of Mathematical Machines; Murray: Computing Mechanisms; Svoboda: Numerical Mathematical Analysis; Scarborough.

MECHANICS

Mc Courses

Plane Dynamics I	Mc-101
Plane Dynamics II	Mc-102
Space Dynamics I	Mc-103
Methods in Dynamics	Mc-201
Vibrations	Mc-311
Dynamics of Engine and Shaft	Mc-341
Exterior Ballistics	Mc-401
Dynamics of a Rigid Body	Mc-402
Interior Ballistics	Mc-421
Strength of Guns	Mc-431
Statics of Structures	Mc-801

Mc-101 PLANE DYNAMICS I 3-0

Introduction to vectors. Fundamental laws of mechanics. Equilibrium of particles and systems of particles: moments, equipollent force systems, reduction of force systems, work and potential energy, virtual work and the principle of virtual work. Equilibrium of a rigid body. Kinematics of a particle, components of velocity and acceleration, plane motion of a rigid body, instantaneous center. Motion of a particle and systems of particles, The principles of linear and angular mementum, the principle of energy, d'Alembert's principle.

Text: Principles of Mechanics, Synge and Griffith.

Prerequisite: Special review course in mechanics, or the equivalent.

Mc-102 PLANE DYNAMICS II 3-0

Moving frames of reference, Coriolis forces, statical effects of earth's rotation. Motion of a projectile, harmonic oscillator, forced oscillations. Dimensional analysis. Moments and products of inertia and principal axes for laminas. Kinetic energy and angular momentum of rigid bodies in plane motion, rotation about fixed axis, general plane motion of rigid body. Normal modes of vibration, degrees of freedom, stability of equilibrium, balancing, plane impulsive motion, principles of linear and angular momentum, collision.

Text: Principles of Mechanics, Synge and Griffith

Prerequisite: Mc-101.

Mc-103 SPACE DYNAMICS I 2-0

Space kinematics: components of velocity and acceleration, angular velocity, general motion of a rigid body. Moments and products of inertia, the momental ellipsoid, principal axes, equimomental systems. Kinetic energy of rigid bodies, angular momentum of rigid bodies. Dynamics in space: the principles of linear and angular momentum, the principle of energy. Moving frames of reference, rigid body with one point fixed, Euler's equations for rigid body with one point fixed. Impulsive motion.

Text: Principles of Mechanics, Synge and Griffith.

Prerequisite: Mc-102.

Mc-201 METHODS IN DYNAMICS 2-2

The principles of (a) linear momentum (b) angular momentum (c) work and energy (d) power and time rate of energy (e) conservation of energy (f) virtual work and (g) d'Alembert are developed and discussed in detail. This work is followed by a development and interpretation of Lagrange's equations of motion. The application of these various principles to obtain the differential equations of motion of dynamical systems is given particular attention. Numerous exercises in the writing of differential equations of motion are assigned.

Text: Principles of Mechanics, Synge and Griffith: Advanced Dynamics, Timoshenko and Young.

Prerequisites: Ma-103 and Mc-102.

Mc-311 VIBRATIONS 3-2

Kinematics of vibration, harmonic analysis. Study of the free and forced vibrations of mechanical systems with one degree of freedom. Systems with many degrees of freedom, normal modes of vibration, computation of the fastest and slowest modes by iteration. Systems with an infinite number of degrees of freedom. Applications to strings, beams, shafts, and membranes. Rayleigh's method, Stodola's method. Critical speeds, self excited vibrations. Experimental determination of the vibration parameters.

Text: Mechanical Vibrations, Den Hartog.

Prerequisites: Ma-104, Mc-102 and ME-500.

Mc-341 DYNAMICS OF ENGINE AND SHAFT 3-0

Motion of pistons and connecting rods of reciprocating mechanisms, with determination of harmonics of inertia forces. Balance of shaking forces, rocking moments, and rolling moments for engines with cylinders in line, with two or more banks, and radial engines. Analysis of turning moment for two- and four- cycle engines. Study of free and forced vibrations of elastic bodies, with emphasis on frequencies and resonance characteristics of elastic bars and shafting with various types of loading. Particular attention is given to torsional and transverse vibrations of a rotating shaft due to torsional impulses and to unbalanced rotors.

Text: Dynamics of Engine and Shaft, Root.

Prerequisite: Ma-104, Mc-102.

Mc-401 EXTERIOR BALLISTICS 3-0

The topics which are presented include the vacuum trajectory, air resistance, various forms of drag function, the Siacci method, numerical integration of the differential equations of motion under normal condidtions, differential corrections for abnormal conditions, weighting factors, the integration of the adjoint system. The projectile is treated as a mass particle, stability considerations being deferred until a later course (Mc-402).

Texts: A Course in Exterior Ballistics; Ritter: Exterior Ballistics; Herrmann: Elementary Vector Analysis; Weatherburn: Course in Exterior Ballistics; (War Department): Method of Numerical Integration in Exterior Ballistics; Jackson: Artillery Circular M. (Ingall's Ballistics Tables).

Prerequisites: Ma-155, Mc-102.

Mc-402 DYNAMICS OF A RIGID BODY 3-0

The fundamental principles of the dynamics of rotating rigid bodies are emphasized throughout the course. These principles are applied to a variety of mechanical systems, in an effort to train the student to analyze many physical problems other than those specifically discussed. Amony the latter are: the effect of the earth's rotation on long trajectories; the motion of a gyroscope under various constraints; the stability of a rotating projectile in flight.

Texts: Principles of Mechanics; Synge and Griffith: New Methods in Exterior Ballistics; Moulton: Elementary Vector Analysis; Weatherburn: War Department Ordnance Pamphlet No. 1051.

Prerequisite: Mc-401.

Mc-421 INTERIOR BALLISTICS 2-0

Those thermodynamic and mechanical concepts and relations which are fundamental to all interior ballistics systems are treated early in the course. These topics are followed by detailed studies (including computational exercises) in particular systems, among which are the LeDuc system and several of those developed during the two World Wars.

Texts: The Equations of Motion of Interior Ballistics; St. Clair: Textbook of Ballistics, Vol. II, parts 1 and 2; Cranz: Naval Ordnance (1939).

Prerequisites: Ma-103, Mc-102, Ch-101.

Mc-431 STRENGTH OF GUNS 3-0

Fundamental principles in the theory of elasticity and strength of materials are presented during the first part of the course, and are then applied to yield the classical thick-cylinder formulas. This is followed by a discussion of those theories of strength which have been employed in the design of guns. Detailed studies, with accompanying computational exercises, are made of the maximum strain theory, for the case of built-up guns, and of the Duguet theory of radial expansion.

Texts: Treatise on the Radial Expansion of Guns; Jeansen: Notes on Theories and Formulas for Radial Expansion; Blandy: Lining of Radially Expanded Guns; Nimitz: Naval Ordnance (1933)

Prerequisites: Ma-104, Mc-102, ME-500.

Mc-801 STATICS OF STRUCTURES 2-0

Graphical statics; the funicular polygon. Simple trusses; Maxwell-Cremona Diagram; phantom members. Statically determinate constraint of a rigid body in a plane. Compound trusses; complex trusses; Henneberg's method. Distributed forces in a plane, Statically determinate constraint of a rigid body in space; simple, compound and complex space frames. Moments of inertia of lamina; rotation of axes; Mohr's circle; ellipses of inertia and gyration.

Texts: Analytical Mechanics for Engineers; Seely H Ensign: Engineering Mechanics - Statics.

Prerequisite: Special review course in mechanics, or the equivalent.

Me Courses

Engineering Thermodynamics	ME-111
Engineering Thermodynamics	ME-112
Engineering Thermodynamics	ME-122
Engineering Thermodynamics	ME-131
Engineering Thermodynamics	ME-132
Chemical Engineering Thermodynamics	ME-141
Chemical Engineering Thermodynamics	ME-142
Chemical Engineering Thermodynamics	ME-143
Power Plant Equipment	ME-211
Power Plant Equipment	ME-212
Power Plant Equipment	ME-212a
Power Plant Analysis (Marine)	ME-215
Power Plant Design (Marine)	ME-216
Internal Combustion Engines (Diesel)	ME-217
Power Plant Equipment	ME-221
Power Plant Equipment	ME-222
Power Plant Analysis (Marine)	ME-223
Power Plant Analysis (Marine)	ME-224
Heat Transmission	ME-310
Hydraulic Equipment	ME-411
Hydrodynamics	ME-412
Compressible Fluid Flow	ME-413
Hydraulic Equipment	ME-421
Hydraulic Equipment	ME-422
Strength of Materials	ME-500
Strength of Materials	ME-509
Strength of Materials	ME-511
Advanced Strength of Materials	ME-512
Advanced Strength of Materials	ME-522

Introduction to the Theory of Elasticity	ME-590
Materials Testing Laboratory	ME-601
Materials Testing Laboratory	ME-611
Experimental Stress Analysis	ME-632
Experimental Stress Analysis	ME-634
Mechanics of Machinery	ME-700
Dynamics of Machinery	ME-710
Dynamics of Machinery	ME-730
Machine Design	ME-811
Advanced Machine Design	ME-812
Machine Design	ME-830
Manufacturing Engineering	ME-840

ME-111 ENGINEERING THERMODYNAMICS 4-2

Stored and transitional energies, their accounting by energy equations in dynamic and chemical processes. Aspects of reversibility, thermodynamic scale of temperature, entropy of energy and the entropy function, Second and Third Laws of thermodynamics, Maxwell relations. Phase rule, thermodynamic properties of liquids and vapors in equilibrial and metastable states, property tables and diagrams, representative reversible and irreversible processes in vapor and liquid phases. Property relations, tables and diagrams for ideal or quasi-ideal gases, representative reversible and irreversible processes with these, kinetic theory of gases.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: Ma-102.

ME-112 ENGINEERING THERMODYNAMICS 4-2

Properties of mixtures of quasi-ideal gases, low-pressure gas-vapor mixtures and related indices, saturation by isobaric cooling, isobaric evaporation and adiabatic expansion and other representative processes, multi- and mono-pressure hygrometric diagrams. Non-ideal gases, their p-v-T correlation by equation and by compressibility diagrams, residual enthalpy and entropy functions and their determination from compressibility and throttling data, representative processes and generation of thermodynamic diagrams. Combustion of fuels and material balances, fuel calorimetry, chemical equilibrium and equilibrium constant, rich-mixture and thin-mixture combustion, flame temperatures.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: ME-111.

ME-122 ENGINEERING THERMODYNAMICS 3-2

Studies included are as indicated for course ME-112 except for omission of considerations of the thermodynamic properties and property correlations for non-ideal gases.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: ME-112

ME-131 ENGINEERING THERMODYNAMICS 4-2

Stored and transitional energies, their accounting by energy equations in dynamic and chemical processes. Aspects of reversibility, thermodynamic scale of temperature, entropy of energy and the entropy property, Second and Third Laws of thermodynamics, Maxwell relations. Phase rule, thermodynamic characteristics of liquids and vapors. Property relations, tables and diagrams for ideal or quasi-ideal gases and representative reversible and irreversible processes with these. Gas mixtures, low pressure gas-vapor mixtures and their indices, saturation by isobaric cooling, isobaric evaporation and adiabatic expansion, multi- and mono-pressure hygrometric charts.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: Ma-102.

ME-132 ENGINEERING THERMODYNAMICS 4-2

Combustion of fuels and material balances, fuel calorimetry, chemical equilibrium and the equilibrium constant, rich-mixture and thin-mixture combustion, flame temperature. Internal combustion power cycles, elementary gas turbine power plant, influences of regenerative preheating, reheating et cetera, performance indices. Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, normal compression shock, Fanno and Reyleigh lines, dynamics of the jet and diverted flow. Thermodynamics of the atmosphere. Associated problems and laboratory work.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: ME-131.

ME-141 CHEMICAL ENGINEERING THERMODYNAMICS 4-2

This course is an introduction to the fundamental concepts of thermodynamics; energy and its accounting; availability of energy; the thermodynamic properties of pure substances and their changes in various processes, including chemical interaction. Emphasis is placed on those topics essential for subsequent studies of explosives, torpedo power plants, jet engines, and similar applications where non-standard fluids are involved.

The laboratory periods are used for student solution of practical problems chosen to illustrate the principles discussed in the classroom.

Text: Principles of Engineering Thermodynamics, Kiefer, Stuart & Kinney.

Prerequisite: Ma-103.

ME-142 CHEMICAL ENGINEERING THERMODYNAMICS 2-2

Organization of the thermodynamic properties of non-ideal gases through the use of the residual functions, preparation and use of thermodynamic diagrams for simple systems of ideal and non-ideal gases and for complex systems in chemical equilibrium, heat and work effects in representative processes involving complex mixtures such as the products of combustion. This course is a continuation of ME-141.

The laboratory periods are used for student solution of practical problems to illustrate the principles discussed in the classroom.

Text: Principles of Engineering Thermodynamics, Kiefer, Stuart & Kinney.

Prerequisite: ME-141.

ME-143 CHEMICAL ENGINEERING THERMODYNAMICS 4-4

The application of thermodynamic facilities to power plants operating on non-standard fluids such as jet engines and torpedo motors; nozzle and blading design factors, performance characteristics, etc. A brief introduction to heat transfer is included.

The laboratory periods are used for student solution of practical problems of related nature.

Text: Principles of Engineering Thermodynamics, Kiefer, Stuart & Kinney; Steam Turbine; Church.

Prerequisite: ME-142.

ME-211 POWER PLANT EQUIPMENT 3-2

Marine boiler performance analysis and characteristics. Steam power plant cycles, influence of regenerative feed heating and of reheating, performance indices. Internal combustion power cycles, elementary gas turbine power plant, influences of regenerative preheating and of reheating, performance indices. Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, normal compression shock, Fanno and Rayleigh lines, dynamics of jet and of diverted flow. Associated problems and laboratory work.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart: miscellaneous supplementary material.

Prerequisite: ME-111, 112, 310, 411.

ME-212 POWER PLANT EQUIPMENT 3-4

Thermodynamic aspects of the turbine, impulse and reaction types, of the reciprocating engine, the gas compressor and blower. Refrigeration and heat pump cycles, refrigerants, multi-level refrigeration, absorption cycles. Air conditioning requirements and equipment, associated laboratory work.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart: Refrigeration and Air Conditioning; Raber & Hutchinson; miscellaneous supplementary material.

Prerequisite: ME-211.

ME-212a POWER PLANT EQUIPMENT 3-2

Studies included are as indicated for course ME-212 except that less time is available for associated laboratory work.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart: miscellaneous supplementary material.

Prerequisite: ME-111, 112, 310, 411.

ME-215 POWER PLANT ANALYSIS (Marine) 2-4

The studies include preliminary methods of estimating for a hypothetical naval ship the main and auxiliary power requirements, inter-relationship of individual equipment items, and computation of various plant performance indices; the evaluation of flow diagrams and heat balance analyses of representative naval power plants. The P.W. periods are largely used in related computations and compilations.

Text: Marine Engineering; Seward.

Prerequisites: ME-212, ME-310 and ME-412.

ME-216 POWER PLANT DESIGN (Marine) 2-4

This course, in continuation of ME-215, includes additional heat balance analyses of representative naval power plants. It further includes studies of the design methods employed in the over-all planning of power plants, of their principal components, and the various practical factors and special military requirements which influence the design. The available time is distributed between student project work, seminar, and lectures by authorities in the various specialized fields of naval marine engineering.

Text: Marine Engineering; Seward: Bureau Ships publications and data.

Prerequisites: ME-215

ME-217 INTERNAL COMBUSTION ENGINES (Diesel) 4-2

The studies include the thermodynamic analysis of the fundamental cycle, ideal and actual combustion processes, cyclic processes, injection phenomena and methods of injection system analysis, and the variables that effect the efficiency and performance of the engine.

The laboratory work includes a series of tests on various engines to determine volumetric and mechanical efficiency, speed-torque characteristics, fuel consumption rates, effect of injection system variables upon engine performance, analysis of high speed engine indicator card, etc.

Text: Internal Combustion Engines; Lichty: Internal Combustion Engines; Taylor & Taylor.

Prerequisites: ME-111, ME-112.

ME-221 POWER PLANT EQUIPMENT 3-2

Elements of heat transmission. Marine boiler performance analysis and characteristics. Steam power plant cycles, influences of regenerative feed heating and of reheating, performance indices. Internal combustion power cycles, elementary gas turbine power plant, influence of regenerative pre-heating and of reheating, performance indices. Thermodynamic aspects of flow of compressible fluids in nozzle, diffuser and duct, dynamics of jet and of diverted flow. Associated problems and laboratory work.

Text: Engineering Thermodynamics; Kiefer, Stuart & Kinney: miscellaneous supplementary material.

Prerequisite: ME-111, 122, 411.

ME-222 POWER PLANT EQUIPMENT 3-4

Thermodynami aspects of the turbine, impulse and reaction types, of the reciprocating engine, the gas compressor and blower. Refrigeration and heat pump cycles, refrigerants, multi-level refrigeration, absorption cycles. Air conditioning requirements and equipment. Associated laboratory work.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart: Miscellaneous supplementary material.

Prerequisite: ME-221.

ME-223 POWER PLANT ANALYSIS (Marine) 2-0

The studies include preliminary methods of estimating for a hypothetical naval ship the main and auxillary power requirements, inter-relationship of individual equipment items, and computation of various plant performance indices.

Text: Marine Engineering; Seward.

Prerequisites: ME-221 and ME-421.

ME-224 POWER PLANT ANALYSIS (Marine) 0-6

This course, in continuation of ME-223, includes studies of representative naval power plants by analysis of their heat balance and flow diagrams, and of the practical factors and special military requirements that influence naval power plant design.

Texts: Marine Engineering; Seward: Bureau Ships publications and data.

Prerequisites: ME-223.

ME-310 HEAT TRANSMISSION 3-2

General manners of energy transition by temperature potential, characteristic thermal circuits, concepts and correlation of individual and overall heat transfer coefficients. Fourier's general law of conduction, applications to representative steady-state situations and unsteady-state conditions, Schmidt and relaxation methods of approximation. Covvection phases of thermal circuits, free and forced, and ones involving vaporization and condensation. Heat radiation. Associated analyses and laboratory work.

Text: Heat Transmission; McAdams: miscellaneous supplementary material.

Prerequisite: ME-111, 122, 411.

ME-411 HYDRAULIC EQUIPMENT 4-2

The studies include the mechanical properties of liquids, hydrostatic pressures and forces on submerged surfaces and associated matters of buoyancy and ship stability, energy aspects of liquid flow, the resistance of such flow through pipes, liquid flow metering and control and the employment of these in hydraulic force transmission and arrester systems, the dynamic forces associated with flow through confining channels, the centrifugal pump and hydrodynamic coupling, etc. The principle of dynamic similarity and dimensional analysis are developed and employed extensively. The P.W. periods are used for student's solution of related practical problems and for related laboratory tests.

Text: Mechanica of Hydraulic Equipment; PG Stencil No. 2217.

Prerequisite: Ma-103.

ME-412 HYDRODYNAMICS 4-2

The course outline includes: Fluid flow concepts; Fundamentals of frictionless fluid flow; Theorems and basic flow definitions; Three dimensional flow examples; Application of complex variables to two-dimensional fluid flow; Two dimensional flow examples; Blasius theorem - flow around cylinders and airfoils; Schwarz-Christoffel theorem - free streamlines; Vortex motion; Equations for viscous flow; The boundary layer.

Text: Fluid Dynamics; V.L. Streeter.

Prerequisites: ME-411 and Ma-104.

ME-413 COMPRESSIBLE FLUID FLOW 3-0

Extension of the studies of course ME-211, 411 and 412 to considerations of the dynamics of two-and three dimensional flow of compressible fluids, expansion and compression shock phenomena, Prandtl-Meyer phenomena, turbulent flow, turbine and compressor blading characteristics et cetera.

Texts: Aerodynamics of Compressible Fluid; Liepmann & Puckett: Miscellaneous supplementary material.

Prerequisite: ME-211, 411, 412.

ME-421 HYDRAULIC EQUIPMENT 3-2

The course outline includes: Mechanical properties of fluids; Hydrostatic pressures and forces; Buoyancy and stability; Energy of flow; Resistance to flow; Fluid flow metering; Hydraulic force and arrester systems.

Text: PG Stencil No. 2217, Mechanics of Hydraulic Equipment.

Prerequisites: Ma-103 or the equivalent.

ME-422 HYDRAULIC EQUIPMENT 2-2

The course outline includes: Dynamic forces associated with fluid flow; Centrifugal pumps; Hydrodynamic coupling; Dimensional analysis and dynamical similarity. Ideal fluid flow; Stream function and velocity potential; graphical mapping of stream lines.

Text: PG Stencil No. 2217, Mechanics of Hydraulic Equipment.

Prerequisites: ME-421 and Ma-103 or the equivalent.

ME-500 STRENGTH OF MATERIALS 3-0

The course outline includes: tensile and compressive stresses, shearing stress, Hooke's law, thin-walled cylinders, combined stresses, analysis of plane strain, torsion of circular sectioned members, elementary beam theory, combined loadings and columns.

Text: Elements of Strength of Materials; Timoshenko & Mac Cullough.

Prerequisites: Ma-101 or Ma-102, Mc-111, Mc-141 or Mc-151.

ME-509 STRENGTH OF MATERIALS 5-0

This is an intensive course designed to cover the following topics: General plane and three dimensional stress, general strain, Hooke's law, thin-walled cylinders, torsion of circular shaxts, elementary beam theory, columns, frames, beams on elastic foundations, beam-columns, frames, beams on elastic foundations, beam-columns, thin plates, thick walled cylinders, theories of failure.

Text: Strength of Materials, Vols. I & II, Timoshenko.

Prerequisites: Ma-102 and Mc-152.

ME-511 STRENGTH OF MATERIALS 5-0

The course outline includes: Tensile and compressive stresses, shearing stress, Hooke's law, thin-walled cylinders, combined stresses, analysis of plane strain, torsion of circular sectioned members, elementary beam theory, statically indeterminate problems in bending, beams on elastic foundations.
Text: Strength of Materials, Vols. I & II, Timoshenko.

Prerequisites: Ma-104 and Mc-143 or the equivalent.

ME-512 ADVANCED STRENGTH OF MATERIALS 5-0

The course outline includes: Beam-columns, problesm having radial symmetry, combined loading, columns, strain energy, think plates, thick walled cylinders, fundamental concepts in the theory of elasticity.
Text: Strength of Materials, Vols. I & II, Timoshenko.

Prerequisites: ME-511.

ME-522 ADVANCED STRENGTH OF MATERIALS 3-0

The course outline includes: Statically indeterminate problems in bending, bending beyond the yield point, curved beams, strain energy, mechanical properties of materials.
Text: Elements of Strength of Materials, Timoshenko & MacCullough.

Prerequisites: ME-500 or ME-511.

ME-590 INTRODUCTION TO THE THEORY OF ELASTICITY 3-0

The course outline includes: Plane stress considerations, differential equations of equilibrium and compatibility, the Airy stress function, curvilinear coordinates, problems in plane stress and plane strain, three dimensional stress considerations, St. Venant theory of torsion, energy considerations.
Text: Theory of Elasticity, Timoshenko.

Prerequisites: ME-522 or the equivalent.

ME-601 MATERIALS TESTING LABORATORY 0-2

The course outline includes experiments involving most of the standard tests used in the determination of the mechanical properties of engineering materials. These tests are: tension, compression, torsion, shear, transverse bending, impact, hardness and fatigue.
Text: Testing of Engineering Materials, Muhlenbruch: A.S.T.M. Student Standards.

Prerequisite: This course may be taken subsequent to or concurrent with ME-500.

ME-611 MATERIALS TESTING LABORATORY 2-2

The course outline includes a study of the theories of failure, the evaluation of experimental error and experiments involving most of the standard and some non-standard tests used in the determination of the mechanical properties of engineering materials. These tests include: tension, compression, torsion, shear, transverse bending, impact, hardness, fatigue and column.

Text: Strength of Materials, Vol. II, Timoshenko: Testing and Inspection of Engineering Material, Davis, et al.

Prerequisites: ME-511.

ME-632 EXPERIMENTAL STRESS ANALYSIS 2-2

The course outline includes: Introduction to the theory of elasticity, dimensional analysis, strain gage techniques, photoelasticity, brittle lacquer method, membrane analogy, miscelaneous methods in experimental stress analysis. Laboratory projects will be assigned in which the various facilities available in experimental stress analysis will be used.

Text: Introduction to Experimental Stress Analysis, PG - 4367.

Prerequisite: ME-512 or Ae-204.

ME-634 EXPERIMENTAL STRESS ANALYSIS 3-2

The course outline includes: dimensional analysis, strain gage techniques, photoelasticity, brittle lacquer method, membrane analogy, miscellaneous methods in experimental stress analysis. Diversified laboratory projects will be assigned offering an opportunity to apply the methods of experimental stress analysis to the solution of both static and dynamic problems. The Beggs' deformator will be used as a check on stress resultants and in determining reaction values for loading models.

Text: Introduction to Experimental Stress Analysis, PG-4367.

Prerequisites: ME-512 and ME-590. ME-590 may be taken concurrently.with ME-634.

ME-700 MECHANICS OF MACHINERY 3-2

This is a general service course. The following topics are studied: Linkwork, cams, toothed gearing, trains of mechanisms, velocities, accelerations, static forces and inertia forces in machine members.

The practical work periods are devoted to the solution on the drawing board of selected problems.

Text: Mechanics of Machinery; Ham, Crane.

Prerequisite: Mc-112 or equivalent.

ME-710 DYNAMICS OF MACHINERY 3-2

Studies are made of the following topics: Balancing of solid rotors, Torsional vibrations by the Holzer method, single and two degrees of freedom linear vibrating systems with and without damping, tuned pendulum absorbers, harmonic analysis of the reciprocating engine. Laboratory work includes the following experiments: balancing a solid rotor on a mechanical as well as an electrical balancing machine, vibrating linear damped vibration absorbers on the Westinghouse equipment, and operating a torsional vibration inducer unit.

Text: Mechanical Vibrations, J.P. DenHartog; Notes by E. K. Gatcombe.

Prerequisites: Ma-104, Mc-143, ME-511.

ME-730 DYNAMICS OF MACHINERY 3-2

Studies are made of the following topics: Balancing of solid rotors, torsional vibration analysis by the Holzer method, single and two degrees of freedom linear vibrating systems with and without damping, tuned pendulum absorbers, harmonic analysis of the radial aircraft engine. The laboratory work includes the following experiments: balancing of solid rotors on the mechanical as well as the electrical balancing machine, vibrating linear damped vibration absorbers on the Westinghouse equipment, and operating a torsional vibration inducer unit.

Texts: Mechanical Vibrations, J. P. DenHartog: Notes, E. K. Gatcombe.

Prerequisites: Ma-114, Mc-112, Ae-202.

ME-811 MACHINE DESIGN 3-2

Review of strength of materials, selection of materials, stress- concentration, bearings, fits and tolerances. Several short design projects as follows: Tabulation of tolerances for shafts and holes for the various classes of fits, accumulation of tolerances in machines, design of an armature shaft, spring design, screw fastening design, design of a power screw, and the design of a set of gears. Studies of belt and chain drives, brakes, clutches, cams, and thin and thick cylinders.

Texts: Design of Machine Elements, Vallance: Notes, E. K. Gatcombe.

Prerequisites: ME-522 or equivalent, ME-700.

ME-812 ADVANCED MACHINE DESIGN 3-4

Several practical design projects will be completed on the drawing board. The projects will give the students an opportunity to combine theory with practice. The drawings involved in the projects will be completely simensioned, proper materials selected, correct base references, surfaces for machining and inspecting will be chosen, proper fits and tolerances will be chosen for interchangeable manufacture. The objective is to create designs which may actually be fabricated.

Texts: Notes, E. K. Gatcombe.

Prerequisites: ME-811.

ME-830 MACHINE DESIGN 4-2

Review of Strength of Materials, Selection of Materials for different designs, Stress-concentration, bearing design, fits and tolerances. Several short design projects as follows: Tabulation of tolerances for shafts and holes for various classes of fits, accumulation of tolerances in machines, design of an armature shaft, spring design, screw fastening design, design of a power screw, and the design of a set of gears. Studies of belt and chain drives, brakes, clutches, cams, and thin and thick cylinder design.

Texts: Design of Machine Members, Vallance: Notes, E. K. Gatcombe.

Prerequisites: ME-700, Ae-202.

M_E-840 MANUFACTURING ENGINEERING 3-2

The following topics are studied: The principles of interchangeable manufacture, the selection of and use of the proper machine tools to fulfill a specific requirement, the details of gage design and inspection methods with reference to proper fits and tolerances. Several industrial plans will be visited where lectures on the use of machines will be provided.

Texts: Interchangeable Manufacturing, E. Buckingham.

Prerequisites: ME-811.

AEROLOGY

Mr Courses

Fundamentals of Atmospheric Circulation	Mr-101
Radiological Defense	Mr-110
Introduction to Synoptic Meteorology	Mr-200
Weather Maps and Codes	Mr-201
Surface Weather Maps Analysis and Forecasting	Mr-202
Weather Analysis and Forecasting	Mr-203
Advanced Weather Analysis and Forecasting	Mr-204
Upper-Air Analysis	Mr-205
Introduction to Synoptic Meteorology	Mr-210
Weather Maps and Codes	Mr-211
Surface Weather Map Analysis	Mr-212
Map Analysis and Forecasting	Mr-213
Weather Analysis and Forecasting	Mr-214
Weather Analysis and Forecasting	Mr-221
Weather Analysis and Forecasting	Mr-222
Advanced Weather Analysis and Forecasting	Mr-223
Advanced Weather Analysis and Forecasting	Mr-224
Upper-Air Analysis	Mr-225
Southern Hemisphere and Tropical Meteorology	Mr-228
Selected Topics in Applied Meteorology	Mr-229
Synoptic Meteorology	Mr-301
Synoptic Meteorology	Mr-302
Dynamic Meteorology I	Mr-321
Dynamic Meteorology II	Mr-322
Dynamic Meteorology III	Mr-323
Meteorological Charts and Diagrams	Mr-402
Physical Meteorology and Physical Oceanography	Mr-403

Wave, Swell and Surf Forecasting	Mr-404
Meteorological Instruments	Mr-410
Thermodynamics of Meteorology	Mr-411
Physical Meteorology	Mr-412
Wave, Swell and Surf Forecasting	Mr-420
The Upper Atmosphere	Mr-422
Climatology	Mr-510
Seminar	Mr-810
Thesis I	Mr-921
Thesis II	Mr-922

Mr-101 FUNDAMENTALS OF ATMOSPHERIC CIRCULATION 3-0

This course serves as an introductory course in Meteorology, especially as it concerns large-and small-scale circulations, and the variations of these with height. It is designed primarily to give student officers in related subjects the required meteorological backgrounds, and, at the same time, to outline possible inter-relationships between the subjects.

Text: Introduction ot Meteorology; Petterssen.

Prerequisites: None.

Mr-110 RADIOLOGICAL DEFENSE 2-0

This course is devoted to discussions of explosion phenomena, the effects of blast and radiation, the aerological problem of fall-out, decontamination, and organization and training for Radiological Defense.

Text: USF 85.

Prerequisites: Ph-190; Mr-302 for MA group. Mr-323 for M2 and MS groups.

Mr-200 INTRODUCTION TO SYNOPTIC METEOROLOGY 3-0

This course serves as a preparation for advanced study of synoptic meteorology. It is primarily an introduction to synoptic meteorology as a survey course, considering in turn the composition of the atmosphere, general circulation, air masses and air-mass changes, fronts, cyclones and anti cyclones, weather analysis and weather forecasting.

Text: Introduction to Synoptic Meteorology; Petterssen.

Prerequisites: None.

Mr-201 WEATHER MAPS AND CODES 2-12

This course is concerned with the problems of observing, transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing; the reduction of the observed facts into short coded messages; and the decoding and plotting of the data on the standard charts used for weather analysis. A series of lectures and motion pictures is presented to give the student officers an outline of the principles of meteorology. Finally, the students analyze an idealized and a three-hourly series of weather maps.

Texts: Hydrographic Office Publication H.O. 206: U. S. Weather Bureau-Circulars "S"and "N", Radiosonde Code, International Code: Aerographer's Manual.

Prerequisites: None.

Mr-202 SURFACE WEATHER MAP ANALYSIS AND FORECASTING 2-12

The principles of surface weather map analysis are demonstrated by having the students analyze current daily weather charts; correlate upper wind data with the surface charts; observe the local surface weather elements; discuss the map analysis; and make trial forecasts.

Text: Handbook of Meteorology; Berry, Bollay, Beers: Practical Aids in Weather Map Analysis; Lockhart: Weather Analysis and Forecasting; Peterssen.

Prerequisites: Mr-200; Mr-201.

Mr-203 WEATHER ANALYSIS AND FORECASTING 2-12

This course is a continuation of course Mr-202. More advanced methods of current weather map analysis and forecasting are presented; and emphasis is placed on the application of analysis and forecast techniques previously presented in the theoretical courses. The students are taught the usefulness of upper air observations in determining air-mass characteristics, movements, etc. Daily forcasts and map discussions are included.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Constant Pressure Analysis; NavAer 50-1R-177: Constant Pressure and Differential Analysis; Haltiner, Eaton: A Collection and Evaluation of Weather Forecasting Rules; NavAer 50-1R-204.

Prerequisites: Mr-202; Mr-301; Mr-402.

Mr-204 ADVANCED WEATHER ANALYSIS AND FORECASTING 0-15

This course is a continuation of course Mr-203. The student officers are taught to analyze and forecast the weather in accordance with the most advanced applied methods, using all available sources of information, including the surface maps, upper-level charts, wind-aloft dats, and meteorograph and radiosonde observations. The course is coordinated with course Mr-205, wherein the upper level charts are drawn, and differential analysis, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Text: None.

Prerequisites: Mr-203; Mr-302; Mr-403.

Mr-205 UPPER AIR ANALYSIS 0-10

The course is devoted entirely to upper-air analysis (supplemented by surface map analysis in Mr-204) including constant-pressure analysis, cross-sections, etc.

Text: None.

Prerequisites: Mr-302; Mr-203; Mr-403.

Mr-210 INTRODUCTION TO SYNOPTIC METEOROLOGY 5-0

This course is a survey of synoptic meteorology, designed to serve as a preparation for study of the various topics considered in the several subsequent advanced courses in meteorology, and as a preparation for laboratory study of weather map analysis and forecasting. It studies successively the distribution of insolation and atmospheric and terrestial temperature, the general circulation of the atmosphere, and the major aspects of the air-mass and frontal systems of weather analysis.

Texts: Introduction to Meteorology; Petterssen: Oceanography for Meteorologists; Sverdrup.

Prerequisites: None.

Mr-211 WEATHER MAPS AND CODES 2-9

This course is concerned with the problems of observing, transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing and the reduction of the observed facts into short coded messages; the decoding and plotting of the data on the standard charts used for weather analysis. A series of lectures and motion pictures is presented to give the student officers an outline of the principles of meteorology.

Texts: Hydrographic Office Publication H.O. 206; U. S. Weather Bureau - Circulars "S" and "N", Radiosonde Code, International Code: Aerographer's Manual.

Prerequisites: None.

Mr-212 SURFACE WEATHER MAP ANALYSIS 1-12

The first principles of surface weather map analysis are demonstrated by having the students analyze an idealized series of weather maps based upon weather observations in the United States. This series is accompanied by a written discussion of each map, giving the criteria to be applied for acceptable analysis. A sequence of maps, at three-hourly intervals, is next analyzed in order to develop concepts of historical sequence and movements of systems. This concerns data for North America and the Eastern and Weatern approaches thereto. The last half of the course is devoted to daily analysis of the current weather charts, including ocean areas; correlation of upper winds with the surface data; practical observations of local weather elements; group discussions of the map analyses; and trial forecasting.

Text: Handbook of Meteorology; Berry, Bollay, Beers: Practical Aids in Weather Map Analysis; Lockhart: Weather Analysis and Forecasting; Petterssen.

Prerequisite: Mr-211.

Mr-213 MAP ANALYSIS AND FORECASTING 0-9

This course is a continuation of Course Mr-212. More advanced methods of current weather map analysis and forecasting are presented. The air-mass and frontal concepts are stressed, and the application of analysis and forecast techniques previously presented in the theoretical Course Mr-210 are brought out.

Text: None.

Prerequisites: Mr-212; Mr-210.

Mr-214 WEATHER ANALYSIS AND FORECASTING 2-9

This is a continuation of Course Mr-213. The students are taught the usefulness of upper-air observations in determining air-mass characteristics, movements, etc.; and the correlation of these observations with the surface map analysis and the forecasts. This, together with additional surface analysis techniques and practical applications of the Technical Course Mr-321, introduces the students to three-dimensional weather analysis. Map discussions and practics forecasting are continued.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Weather Analysis and Forecasting; Petterssen: Constant Pressure Analysis; NavAer 50-1R-177: Constant Pressure and Differential Analyses; Haltiner and Eaton: NavAer 50-1R-216.

Prerequisites: Mr-213; Mr-411

Mr-221 WEATHER ANALYSIS AND FORECASTING 1-9

This course continues the instruction given in Course Mr-214. The students are required to become familiar with upper-level charts, and prepare surface prognostic charts. These are correlated with the surface map analysis to give a three-dimensional analysis. The weather analysis discussions and forecasts are continued.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Weather Analysis and Forecasting; Petterssen: A collection and Evaluation of Weather Forecasting Rules; NavAer 50-1R-204.

Prerequisites: Mr-214; Mr-321; Mr-412.

Mr-222 WEATHER ANALYSIS AND FORECASTING 0-12

A continuation of Course Mr-221.

Text: None.

Prerequisites: Mr-221; Mr-322.

Mr-223 ADVANCED WEATHER ANALYSIS AND FORECASTING 0-9

A continuation of Course Mr-222.

Text: None.

Prerequisites: Mr-222; Mr-229; Mr-323.

Mr-224 ADVANCED WEATHER ANALYSIS AND FORECASTING 0-15

This course is a continuation of Course Mr-223. The student officers are taught to analyze and forecast the weather in accordance with the most advanced methods, using all available sources of information, including the surface maps, local conditions, upper-level charts, winds aloft, and meterograph and radiosonde observations. The practical aspects of Course Mr-220 are demonstrated and the course is coordinated with Course Mr-225 wherein the upper-level charts are drawn, and differential analyses, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Text: None.

Prerequisite: Mr-223.

Mr-225 UPPER-AIR ANALYSIS 0-10

The course is devoted entirely to upper-air analysis (supplemented by surface map analysis in Mr-224) including constant-pressure analysis, cross-sections, etc.

Text: None.

Prerequisite: Mr-223.

Mr-228 SOUTHERN HEMISPHERE AND TROPICAL METEOROLOGY 2-0

The course consists of lectures and reading assignments dealing with the synoptic aspects of Southern Hemisphere meteorology, tropical synoptic models (with particular emphasis on the tropical cyclone), and tropical forecasting.

Text: Handbook of Meteorology; Berry, Bollay, Beers: Notes.

Prerequisites: Mr-321; Mr-214.

Mr-229 SELECTED TOPICS IN APPLIED METEOROLOGY 2-0

The course consists of lectures and reading assignments dealing with isentropic analysis, single-station analysis, arctic and antarctic meteorology, extended range forecasting, and any important recent developments in meteorological practice.

Texts: Basic Principles of Weather Forecasting; Starr.

Prerequisites: Mr-221; Mr-322.

Mr-301 SYNOPTIC METEOROLOGY 5-0

This course deals with the fundamental theoretical concepts of synoptic meteorology, covering air-mass and frontal characterists, wind and pressure systems, the general circulation and climatology.

Texts: Weather Analysis and Forecasting; Petterssen: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisites: Mr-200; Ph-190; Ma-161.

Mr-302 SYNOPTIC METEOROLOGY 5-0

This course is a continuation of Mr-301, covering such topics as the thermal wind, differential analysis, the mechanism of pressure changes; stability and instability, Southern Hemisphere and tropical synoptic meteorology, long range and single-station forecasting.

Texts: Weather Analysis and Forecasting; Petterssen: Handbood of Meteorology; Berry, Bollay, Beers.

Prerequisites: Mr-301; Mr-402; Ma-162.

Mr-321 DYNAMIC METEOROLOGY I 3-0

The course consists of lectures and concurrent reading assignmetns from the texts on the following topics: scalar and vector fields; surfaces of discontinuity; solenoids and the Circulation Theorems; tertiary circulations; secondary circulations of thermal and dynamic types; streamlines and traiectories; hydrostatics and the thermal wind; stability, convection and subsidence.

Texts: Dynamic Meteorology; Holmboe, Forsythe, Gustin: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-411; Mr-210; Ph-196; Ma-103.

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Mr-322 DYNAMIC METEOROLOGY II 3-0

The course is a continuation of Mr-321, covering the following topics: continuity and tendency equations; convergency and divergence; vorticity; frontogenesis and frontolysis; stability, convection and subsidence, the General Circulation and its influence on the formation of air masses.

Texts: Dynamic Meteorology; Holmboe, Forsythe, Gustin: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-321; Ma-134.

Mr-323 DYNAMIC METEOROLOGY III 3-0

This course is a continuation of Mr-322 and considers the following topics: general effects of viscosity; equations of motion for laminar and turbulent flow; dynamic similarity; wind variation in the surface layer; energy changes in wind system; transfer of air properties by turbulent mass exchange; diurnal temperature variations; transformation of air masses.

Texts: Handbook of Meteorology; Berry, Bollay, Beers:. Physical and Dynamical Meteorology; Brunt.

Prerequisites: Mr-322; Ma-135.

Mr-402 METEOROLOGICAL CHARTS AND DIAGRAMS 3-0

The course proceeds from an elementary discussion of the gas laws and the physics of change of state and phase, to their graphical representation on the psuedo-adiabatic diagram, and to techniques of analysis for stability and instability in weather forecasting.

Text: Handbook for Meteorology; Berry, Bollay, Beers.

Prerequisites: Ph-190; Ma-161.

Mr-403 PHYSICAL METEOROLOGY AND PHYSICAL OCEANOGRAPHY 4-0

This course is a qualitative treatment of (1) radiation, solar and terrestrial, and its effect on atmospheric processes; (2) elementary theory of turbulence and diffusion and the effect of these processes on wind structure and air-mass modification; (3) Physical oceanography.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Dynamic Meteorology; Haurwitz.

Prerequisites: Ph-190; Ma-162.

Mr-404 WAVE, SWELL AND SURF FORECASTING 0-2

The student officers are required to solve problems from the texts and make practice forecasts.

Texts: Wind Waves and Swell; Hydrographic Office Publication H.O. Misc. 11,275: Breakers and Surf; H.O. 234.

Mr-410 INSTRUMENTS 2-2

Standard naval meteorological instruments are studied and used by the student. Additional instrumentation peculiar to (1) cold climates, (2) very high elevations, and (3) micrometeorological elements is investigated generally. Special attention is paid to errors and to reliability of observation.

Texts: Meteorological Instruments; Middleton: Aerographer's Manual; Circular "P"; U. S. Weather Bureau: Instrument Workbook; From.

Prerequisite: Ph-196 or Ph-190.

Mr-411 THERMODYNAMICS OF METEOROLOGY 5-2

This course considers the following topics: the physical variables; first and second laws of thermodynamics; concept of entropy; equation of state; properties of gases; properties of water and moist air; thermodynamic diagrams; air mass identification indices; geopotential determinations; stability criteria.

Texts: Dynamic Meteorology; Holmboe, Forsythe, Gustin: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisites: Mr-210; Ma-102; Ph-196.

Mr-412 PHYSICAL METEOROLOGY 3-0

This course deals with (1) solar and terrestrial radiation, and (2) the physics of atmospheric phenomena in which optical or scattering effects are produced by clouds, fogs, raindrops, haze, etc.

Texts: Handbook of Meteorology; Berry, Collay, Beers: Physical Meteorology; Albright.

Prerequisites: Ph-196; Mr-411; Ma-103.

Mr-420 WAVE, SWELL AND SURF FORECASTING 2-1

This course considers the following topics: the characteristics of surface water waves; generation of waves; methods of forecasting sea and swell; methods of forecasting breakers and surf conditions; under water depth determinations; and methods of locating rubber rafts adrift at sea.

Texts: Wind Waves and Swell; Hydrographic Office Publication H.O. Misc. 11,275: Breakers and Surf; H.O. 234.

Prerequisites: Mr-322; Ma-135.

Mr-422 THE UPPER ATMOSPHERE 4-1

A study of selected topics in Physics which lead to an understanding of the physical structure of the high atmosphere. These topics will be selected from (1) sound, (2) kinetic theory, (3) electromagnetic theory, and (4) atomic structure and spectroscopy. Using these tools, the various stratospheric layers and analyzed in order to determine the variation of composition and of the meteorological elements with height.

Texts: Modern Physics; Jauncey: Terrestrial Magnetism and Electricity; Fleming: Physical State of the Upper Atmosphere; Haurwitz.

Prerequisites: Mr-323; Mr-412.

Mr-510 CLIMATOLOGY 2-0

This course considers the major continental and oceanic regions of the world with respect to their dominant weather characteristics and covers the meteorological and oceanographic processes that are important in the development of these characteristics.

Text: Climatology; Haurwitz, Austin.

Prerequisites: Mr-212; Mr-210.

Mr-810 SEMINAR 2-0

Students study and prepare synopses of current publications and original data, concerning meteorology, and present them for group discussion.

Text: None.

Prerequisite: Mr-229.

Mr-921 THESIS I 2-0

Students are expected to begin research on problems selected by themselves or assigned to them. Each student will be directed and assisted in his work by a staff member qualified in the special field of the problem selected.

Text: None.

Prerequisites: Mr-229; Mr-323; Ma-331.

Mr-922 THESIS II 4-0

This course is a continuation of Mr-921. The work begun in Mr-921 will be completed and prepared in proper form for presentation to the Academic Council and/or for publication.

Text: None.

Prerequisites: Mr-921; Mr-422.

METALLURGY

Mt Courses

Production Metallurgy	Mt-101
Production of Steel	Mt-102
Production of Non-Ferrous Metals	Mt-103
Introduction to Physical Metallurgy	Mt-201
Ferrous Physical Metallurgy	Mt-202
Physical Metallurgy	Mt-203
Physical Metallurgy	Mt-204
Advanced Physical Metallurgy	Mt-205
Physics of Metals	Mt-206
High Temperature Materials	Mt-301
Alloy Steels	Mt-302
Metals Seminar	Mt-303
Radiography	Mt-304
Physics of Metals	Mt-401

Mt-101 PRODUCTION METALLURGY 2-0

This course serves as an introduction to the study of metallurgy and is essentially descriptive in nature. Subjects treated include, the occurrence and classification of metal bearing raw materials; the fundamental processes of extractive metallurgy; refractories, fuels, fluxes slags and equipment; a brief summary of steel making and the production of copper and zinc.

Text: Engineering Metallurgy (1938); Stoughton, Butts.

Prerequisite: Ch-101.

Mt-102 PRODUCTION OF STEEL 3-0

The subject matter includes such topics as the occurrence and composition of various iron ores, the blast furnance, its design and operation, blast furnance products. The various methods of steel production and the production of grey, white and malleable cast iron.

Text: Ferrous Production Metallurgy; Bray.

Prerequisites: Ch-101 or Ch-121, Mt-101.

Mt-103 PRODUCTION OF NON-FERROUS METALS 3-0

The subject matter of this course includes a discussion of the sources, the strategic importance of, and the methods of production of the following metals: copper, zinc, lead, tin, aluminum, magnesium, and other metals of technical interest.

Prerequisites: Ch-101 or Ch-121, Mt-101.

Mt-201 INTRODUCTORY PHYSICAL METALLURGY 3-2

This course serves as an introduction to physical metallurgy. Subjects treated include (a) the nature, characteristics and properties of metals, (b) the application of the phase rule to binary and ternary alloy systems and characteristic phase diagrams, (c) the correlation of microstructure, mechanical properties and corrosion resistance of alloys with phase diagrams, (d) mechanical deformation and heat treatment of alloys, and (e) descriptions of representative non-ferrous alloys of commercial importance. The subject matter is illustrated by reference to technically important alloy systems in which the phenomena are commonly observed.

The laboratory experiments are designed to introduce to the student the methods available to the metallurgist for the study of metals and alloys. These include the construction of equilibrium diagrams and metallographic studies of fundamental structures, brass, bronze, bearings, etc.

Text: Principles of Physical Metallurgy; Coonan: Engineering Physical Metallurgy; Heyer.

Prerequisite: None.

Mt-202 FERROUS PHYSICAL METALLURGY 3-2

This course continues the presentation of subject matter introduced in Metals, Mt-201, with emphasis on the alloys of iron. Subjects treated include (a) the iron-carbon alloys, (b) effects of various heat treatments and cooling rates on the structure and properties of steel, (c) isothermal reaction rates and the hardenability of steel, (d) surface hardening methods, (e) characteristics and properties of plain carbon and alloy cast irons, (f) the effect of other alloying elements on steel, (g) tool steels, (h) corrosion and corrosion resisting steels.

The laboratory work includes experiments in the heat treatment of steel, mechanical testing and metallegraphic examination of common ferrous alloys.

Text: Principles of Physical Metallurgy; Coonan: Engineering Physical Metallurgy; Heyer.

Prerequisite: Mt-201.

Mt-203 PHYSICAL METALLURGY 2-2

The subject matter is in part a continuation of that presented in Mt-201 and Mt-202. It includes a discussion of fatigue and fatigue failures, foundry metallurgy and the metallurgy of welding. Consideration is given to developments in powder metallurgy and to the behavior of metals at elevated temperatures. A summary is made on the basis of this and the other metallurgy courses of the causes of defects and failures in metals. Approximately one third of the course is concerned with a study of the alloys of aluminum and magnesium.

Text: Metal Process Engineering; Woldman: Heat Treating Aluminum Alloys; Reynolds Metals Co.

Prerequisites: Mt-201, Mt-202.

Mt-204 PHYSICAL METALLURGY 3-4

The material presented in this course includes a study of phase transformations in steel, isothermal decomposition reactions and products, decomposition on continuous cooling, factors involved in hardenability and methods of evaluating it; time, temperature, transformation treatment of steel, alloy steels, high strength cast irons and cast steels. Introductory discussion of the modern theory of the solid state olid state.

Text: Steel and Its Heat Treatment Vol. I - II; Bullens, 5th Ed.: Theoretical Structural Metallurgy; Cottrell.

Prerequisites: Mt-201, Mt-202.

Mt-205 ADVANCED PHYSICAL METALLURGY 3-4

The subject matter includes a discussion of equilibrium in alloy systems, structure of metals and alloys, phase transformations, mechanism of phase changes, diffusion, types of solid solutions.

Text: Structure of Metals; Barrett.

Prerequisites: Mt-202, Cr-271.

Mt-206 PHYSICS OF METALS 3-2

The subject matter is an extension of that offered in Mt-205 and includes such topics as plastic deformation theories of slip, recrystallization, preferred arientation, ag hardening, etc.

Text: Structure of Metals; Barrett.

Prerequisite: Mt-205.

Mt-301 HIGH TEMPERATURE MATERIALS 3-0

This course includes a study of the methods used in evaluating the probable behavior of materials at elevated temperatures, a consideration of the properties of particular importance in such service; evaluation of present heat resisting alloys; a study of high temperature behavior of alloys used in gas turbines, jets, and rocket motors. A study of ceramics as possible materials for high temperature service is included.

Prerequisites: Mt-201, Mt-202.

Mt-302 ALLOY STEELS 4-2

The subject matter includes a study of the properties of alloy steels, the effect of alloying elements on the structure properties and heat treatment. A detailed consideration is given to tool, die, heat resisting and stainless steels and to high strength and alloy cast irons.

Text: Steel and its Heat Treatment; Bullens 5th Ed.: The Alloying Elements in Steel; Bain.

Prerequisite: Mt-202.

Mt-303 METALS SEMINAR 1-0

Papers from current technical journals will be reported and discussed by students.

Prerequisites: Mt-203, 204 or 205.

Mt-304 RADIOGRAPHY 2-2

This course includes the principles of X-Rayond Gamma Roy radiography. A discussion of the equipment used. Film characteristics and a comparison of radiography with other non-dectructive methods of inspection.

Prerequisites: Mt-202.

Mt-401 PHYSICS OF METALS 2-2

A discussion of the modern theories of the solid state and includes crystal chemistry, interatomic forces, wave nature of electrons, electron theory of metals, reaction tsinetics, fall energy of alloy phases, order disorder transformations etc.

Text: Theoretical Structural Metallurgy, Cattrell.

Prerequisites: Mt-202, Ph-610; Ph-613 or Ph-640.

MARINE ENGINEERING

NE Courses

Main Propulsion	NE-101
Auxiliary Machinery	NE-102
Engineering Department Organization	NE-103

NE-101 MAIN PROPULSION 3-0

This course is a practical study of naval steam-turbine-reduction-gear propulsion plants and their auxiliaries. Subject treated include boilers, forced draft blowers, fuel oil and fuel oil equipment, boiler feed water systems, piping and valves, gaskets and packing, pumps and governors, main turbines, condensers and air ejectors, reduction gears, bearings and shafting propellors, lubrication and lubricants.

Text: Bureau of Ships Manual, Naval Machinery 1946, Bureau of Ships Bulletins of Information, Bureau of Ships Circula Letters.

Prerequisites: None.

NE-102 AUXILIARY MACHINERY 3-0

This course is a practical study of naval machinery other than main propulsion machinery. Subjects treated include auxiliary turbines, mechanical measuring instruments, hydraulic speed gears, diesel (auxiliary) engines, compressed air plants, welding and cutting, distilling plants, refrigeration plants, electrical plants (general), generators and voltage regulators, electrical distribution systems, storage batteries, motors and controllers, lighting, interior communication systems, searchlights and electrical measuring instruments.

Text: Bureau of Ships Manual, Naval Machinery 1946, Bureau of Ships Bulletins of Information. Bureau of Ships Circular Letters.

Prerequisites: None.

NE-103 ENGINEERING DEPARTMENT ORGANIZATION 1-0

This course is a study of the administrative duties of the engineering office afloat. Subjects treated include: Engineering Department Organization, Routine Tests and Inspections, Machinery Index, Machinery History Current Ship's Maintenance Project, Ship's Force Overhauls, Tender Overhauls, Navy Shipyard Overhauls, Supplies, Spare Parts, Requisitions, Engineering Casualty Control, Safety Precautions, Engineering Competition, and Economical Operation of Engineering Plants.

Text used is prepared lecture stencils.

Prerequisites: None.

ORDNANCE and GUNNERY

Or Courses

Ordnance Administration and Special Equipage	Or-103
Surface Fire Control	Or-205
Anti-Aircraft Fire Control	Or-304
Anti-Aircraft Fire Control	Or-305
Guided Missile Guidance	Or-404
Guided Missile Guidance	Or-405
Underwater Ordnance	Or-501
Mine Design	Or-503

NEW WEAPON DEVELOPMENT

SL Lecture Courses

New Weapon Development I	SL-101
New Weapon Development II	SL-102

Or-103 ORDNANCE ADMINISDRACION AND SPECIAL EQUIPAGE 2-0

Organization and administration of the Bureau of Ordnance, powder, explosives, fuses, ammunition, elementary theory and construction of rockets, basic gun design, duties of the gunnery officer.

Texts: Navy Dept. Classified Publications.

Prerequisites: None.

Or-205 SURFACE FIRE CONTROL 2-0

(This course is to follow and introductory course covering an analytical solution of the fire control problem, basic mechanisms, rangekeeper and computer theory). Fundamentals of the surface fire control problem, rangekeeper theory, director systems, synchros, fire control errors and correctors, battery alignment.

Texts: Navy Dept. Classified Publications.

Prerequisite: Or-304 (or equivalent).

Or-304 ANTI-AIRCRAFT FIRE CONTROL 0-3

Lecture Series: Fundamentals of the anti-aircraft fire control problem, analytical solution of the anti-aircraft fire control problem, basic mechanisms, rangekeeper and computer theory, units making up one anti-aircraft fire control system, introduction to fire control errors and correctors.

Texts: Navy Dept. Classified Publications.

Prerequisite: Or-205.

Or-305 ANTI-AIRCRAFT FIRE CONTROL 2-0

Review of the fundamentals of the anti-aircraft fire control problem, theory of gyro lead computing systems, basic electro-mechanical computing equipment.

Texts: Navy Dept. Classified Publications.

Prerequisite: Or-304 (or equivalent).

Or-404 GUIDED MISSILE GUIDANCE 2-0

Continuation of the basic surface to air fire control problem, introduction to guided missiles and guidance systems.

Texts: Navy Dept. Classified Publications.

Prerequisite: Or-304 (or equivalent).

Or-405 GUIDED MISSILE GUIDANCE 1-0

This course is a continuation of Or-404, and consists of a survey of guidance systems and guided missiles.

Texts: Navy Dept. Classified Publications.

Prerequisites: Or-304 (or equivalent) Or-404.

Or-501 UNDERWATER ORDNANCE 2-0

Moored and ground mines, contact and influence firing mechanisms, depth charges and other antisubmarine ordnance, steam, electric and chemical torpedoes, theory and design of torpedo control equipment, harbor defense, nets and booms.

Texts: Navy Dept. Classified Publications.

Prerequisites: None.

Or-503 MINE DESIGN 2-0

Mathematical aspects of minefield planning, detailed design of influence firing mechanisms, design of mine accessories, moored and ground mine sweeping and location, harbor defense.

Texts: Navy Dept. Classified Publications.

Prerequisites: None.

SL-101 NEW WEAPON DEVELOPMENT I 0-1

(Lecture)

This course consists of the first ten (10) lectures of a twenty (20) lecture series to be delivered by authorities in the field of New Weapon Development, the latter term being used in its broadest sense and including such developments as atomic energy, guided missiles, pilotless aircraft, radar, special communication equipment, countermeasures, special fuzes, and jet propulsion.

Prerequisites: None.

SL-102 NEW WEAPON DEVELOPMENT II 0-1

(Lecture)

This course is a continuation of Course SL-101 and consists of the second ten (10) lectures of the twenty (20) lecture series described under SL-101.

Prerequisites: None.

Ph Courses

Dynamics	Ph-113
Analytical Mechanics	Ph-141
Analytical Mechanics	Ph-142
Introduction to Physics (Meteorology)	Ph-190
General Physics (Meteorology)	Ph-196
Geometrical and Physical Optics	Ph-210
Optics	Ph-211
Physical Optics and Introductory Dynamics	Ph-212
Optics and Optical Spectra	Ph-240
Electricity	Ph-311
Electricity and Magnetism	Ph-341
Electronics	Ph-342
Electronics and Radiation Measurements	Ph-343
Electromagnetism	Ph-361
Electromagnetic Waves	Ph-362
Sound	Ph-410
Fundamental Acoustics	Ph-421
Applied Acoustics	Ph-422
Underwater Acoustics	Ph-423
Sonar Systems	Ph-424
Underwater Acoustics	Ph-450
Kinetic Theory and Statistical Mechanics	Ph-540
Atomic Physics	Ph-610
Modern Physics	Ph-631
Atomic Physics	Ph-640
Theoretical Physics	Ph-731
Theoretical Physics	Ph-732

Ph-113 DYNAMICS 3-0

Kinematical and dynamical motions of a particle and of rigid bodies, energy concepts in dynamics, constrained motion, equations of Lagrange and of Hamilton, oscillations of a dynamical system, kinetic theory. Both analytical and vector methods are used.
Text: Physical Mechanics: Lindsay.

Prerequisites: Ma-102; Ph-212.

Ph-141 ANALYTICAL MECHANICS 4-0

Fundamental dynamical concepts, curvilinear motion in a plane, energy concepts, statics and dynamics of a rigid body, both analytical and vector methods are used.
Text: Physical Mechanics; Lindsay.

Prerequisite: Ma-182 (may be taken concurrently)

Ph-142 ANALYTICAL MECHANICS 4-0

Constrained motion; Hamilton's principle; Lagrange's equations; damped oscillations; Maxwell, Bose and Fermi statistics; elements of kinetic theory; wave motion; fluid mechanics.

Prerequisite: Ph-141, Ma-183 (may be taken concurrently)

Ph-190 INTRODUCTION TO PHYSICS (Meteorology) 3-0

The course covers mechanics, wave motion, and heat, by lecture, reading assignments, and solution of simple numerical problems.

Prerequisites: None.

Ph-196 GENERAL PHYSICS (Meterology) 5-1

The course is a survey of the mechanics of solids and fluids, heat and kinetic theory, and wave motion.
Text: Analytical Experimental Physics; Lemon, Ference.

Prerequisites: None.

Ph-210 GEOMETRICAL AND PHYSICAL OPTICS 3-0

The following topics are included: reflection and refraction of light, lenses and lens systems, dispersion, interference, diffraction, polarization, and optical spectra.
Text: Optics; Sears

Prerequisites: None.

Ph-211 OPTICS 3-0

Reflection and refraction of light, lenses and lens aberrations, stops, optical systems, and dispersion.
Text: Optics; Sears: Physical Optics; Jenkins, White.

Prerequisites: None.

Ph-212 PHYSICAL OPTICS AND INTRODUCTORY DYNAMICS 3-3

An analytical presentation of interference, diffraction, polarization, origin of spectra, fluorescence and phosphorescence, with applications to infra-red signalling, optical behavior of radio waves, introductory dynamics. Related laboratory work is included.
Text: Physical Optics; Jenkins, White: Physical Mechanics; Lindsay.

Prerequisite: Ph-211.

Ph-240 OPTICS AND OPTICAL SPECTRA 3-3

The following topics are included: reflection and refraction of light, thin and thick lenses, optical systems, dispersion, interference, diffraction, polarization, and optical spectra.
Text: Optics; Sears.

Prerequisite: None.

Ph-250 GEOMETRICAL AND PHYSICAL OPTICS 3-2

The following topics are included: reflection and refraction of light, lenses and lens systems, despersion, interference, diffraction, polarization and optical spectra.
Text: Optics, Sears.

Prerequisites: None.

Ph-311 ELECTROSTATICS AND MAGNETOSTATICS 3-0

Coulomb's law, Gauss' law, dipoles, dielectric theory, polarization, harmonic solutions of Laplace's equation, electrical images, magnetic dipoles and shells, Ampere's law, magnetic field of current, magnetic theory. Both analytical and vector methods are used.
Text: Principles of Electricity and Electromagnetic; Harnwell.

Prerequisite: Ma-103.

Ph-341 ELECTRICITY AND MAGNETISM 3-0

Electrostatic fields and potentials, induced charges, capacity, steady electric currents, magnetic field of steady currents, induced electromotive forces, alternating currents, displacement currents, electromagnetic waves. The methods of vector analysis are employed.
Text: Principles of Electricity and Electromagnetism; Harnwell.

Prerequisite: Ma-182. (may be taken concurrently).

Ph-342 ELECTRONICS 3-3

A, to a large extent, qualitative treatment of basic electronic circuits and instruments, including the study of emission phenomena, tube static characteristics, power rectifiers and filters, amplifiers, oscillators, modulators, detectors and the cathode ray oscilloscope and vacuum tube voltmeters.

Text: Principles of Electricity and Electromagnetism; Harnwell.

Prerequisite: Ph-341.

Ph-343 ELECTRONICS AND RADIATION MEASUREMENTS 3-3

A study of pulse shaping, trigger circuits and multivibrators with emphasis on their application to counter circuits. A study of the phenomena of electrical discharge in gases and a study of the various instruments used in making radiation measurements.

Text: Principles of Electricity and Electromagnetism; Harnwell.

Prerequisite: Ph-342.

Ph-361 ELECTROMAGNETISM 3-0

Electromagnetic field theory; electrostatics; dielectrices; magnetic fields of currents; vector potential; magnetic materials; magnetomotive force; electromagnetic induction; Maxwell's equations; electromagnetic waves.

Text: Electromagnetism; Slater, Frank

Prerequisite: Ma-103.

Ph-362 ELECTROMATIC WAVES 3-0

Reflection and refranction of electromatic waves; wave guides; cavity resonators; electromagnetic radiation.

Text: Electromagnetism; Slater, Frank.

Prerequisite: Ph-361.

Ph-410 SOUND 3-0

This course provides a brief survey of vibrating systems, and of the problems arising in connection with the radiation, transmission and reception of sound in air and in water.

Text: A Textbook of Sound; Wood, Olson: Elements of Acoustical Engineering.

Prerequisite: Ma-102.

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Ph-421 FUNDAMENTAL ACOUSTICS 3-0

An analytical study of the dynamics of vibrating systems including free, forced, damped, and coupled simple harmonic motion; vibrations of strings, bars, membranes, and diaphrams. A development of the acoustic wave equation. Propagation of plane waves through pipes and between different media. Propagation of spherical waves including radiation from pulsating sphere and circular piston.

Text: Fundamentals of Acoustics; Kinsler, Frey.

Prerequisite: Ma-104.

Ph-422 APPLIED ACOUSTICS 3-0

An analytical treatment of acoustic resonators; acoustic impedance; effects of branches, orifices, and viscosity on propagation of plane waves through pipes; horn, loud speaker, and microphone theory and practice. Fundamentals of acoustical measurements including rating and calibration methods of microphones and loud speakers. Architectural acoustics. Fundamentals of hearing.

Text: Fundamentals of Acoustics; Kinsler, Frey.

Prerequisite: Ph-421.

Ph-423 UNDERWATER ACOUSTICS 2-3

An analytical treatment of the piezoelectric effect and the magnetostriction effect with applications to sonar transducers and to crystal oscillators. Transmission of sound in sea water including problems of refraction, attenuation and reverberation. Physics principles and electronic circuits used in design and operation of modern sonar equipment. Experiments in acoustical measurements, sound beam and sonar equipment measurements, operation of sonar equipment.

Text: Principles of Underwater Sound; NORC Technical Summary.

Prerequisite: Ph-422.

Ph-424 SONAR SYSTEMS 2-4

Various types of sonar equipment are studied in the laboratory (Sonar Barge) and in the classroom.

Prerequisite: Ph-423.

Ph-450 UNDERWATER ACOUSTICS 3-1

An analytic treatment of the fundamentals of acoustics, with particular emphasis on sound radiation and transmission problems encountered in underwater acoustics.

Text: A Textbook of Sound; Wood; NDRC Tech. Summary, Principles of Underwater Sound.

Prerequisite: Ma-102.

Ph-540 KINETIC THEORY AND STATISTICAL MECHANICS 3-0

Properties of an ideal gas, distribution of molecular velocities and energies, equilibrium, Maxwell-Boltzmann distribution, mean free path, collision cooss-section, scattering; electron gas in metals, thermionic emission, Fermi-Dirac and Bose-Einstein Statistics.
Text: Kinetic Theory of Gases; Kennard.

Prerequisites: Ph-113 or Ph-142; Ma-103 or Ma-183.

Ph-610 ATOMIC PHYSICS 3-0

Elementary charged particles, photoelectricity, X-rays, radio-activity, atomic structure, nuclear disintegration.
Text: Atomic Physics; Semat.

Prerequisites: None.

Ph-631 MODERN PHYSICS 4-0

Charges and masses of elementary particles, photoelectricity, X-rays, wave mechanics, nuclear structure and nuclear pawticles, physics of the solid state.
Text: Atomic Physics; Semat.

Prerequisites: Ph-311.

Ph-640 ATOMIC PHYSICS 3-3

Photoelectricity, X-rays, atomic structure, radio-activity, nuclear structure and nuclear disintegration.

Prerequisites: Ph-240 (or Ph-210 or Ph-250), Ph-341 (or Ph-311 may be taken concurrently).

Ph-731 THEORETICAL PHYSICS

Topics in theoretical physics selected to meet the needs of the student.

Ph-732 THEORETICAL PHYSICS

Topics in theoretical physics selected to meet the needs of the student.

PART IV

Groups Commencing Postgraduate Education Away from Postgraduate School

GROUPS COMMENCING POSTGRADUATE EDUCATION AWAY FROM THE NAVAL POSTGRADUATE SCHOOL

Group Designation	Curriculum	Location
G	General Line	Newport, R. I.
G	" "	Monterey, Calif.
NB	Naval Construction and Engineering	Mass. Inst. Tech.
NB2	" " " "	" " "
NB3	" " " "	" " "
NE	Nuclear Engineering	M.I.T.
ZG	Civil Engineering	Rensselaer Poly I.
ZG2	" "	" " "
ZHW	Law at George Washington	George Washington U.
ZH2W	" " " "	" " "
ZH3W	" " " "	" " "
ZHG	Law at Georgtown	Georgetown U.
ZH2G	" " "	" "
ZH3G	" " "	" "
ZI	Naval Intelligence	Anacostia, D.C.
ZK	Advanced Man. (13 weeks)	Harvard U.
ZKH	Business Admin.	" "
ZK2H	" "	" "
ZKS	" "	Stanford U.
ZM	Textile Eng.	Lowell Inst.
ZM2	" "	" "
ZPN	Personnel Admin. and Trg.	Northwestern U.
ZPO	" " " "	Ohio State
ZPS	" " " "	Stanford U.
ZT	Man. and Ind. Eng.	Resselaer Poly I.
ZU	Religion	Various

CIVIL ENGINEERING CURRICULUM

Two years of Postgraduate Training at Rensselaer Polytechnic Institute, Troy, New York.

Successful completion of this course normally leads to appointment in the Civil Engineer Corps.

	First Year		Math. Mech. Survey
5.76	Elem. Structural Anal.	3(5)	
10.11	Engineering Geology	3(4)	
17.16	Strength of Materials Materials Lab.	4(6)	10(15)
5.05	Photogrammetry (CEC)	2(3)	
5.09	Contracts & Specifications	2(2)	
5.32	Soil Mechanics (CEC)	3(5)	
5.77	Structural Design I	3(5)	
5.78	Reinforced Concrete I	3(5)	
7.72	Util. of Electrical Energy in Naval Establishments (CEC)	3(5)	
13.541	Metallurgy & Welding (CEC)	4(6)	20(31)
5.15	Highways & Airports (CEC)	4(6)	
5.75	Building Construction	3(5)	
5.79	Reinforced Concrete II	3(5)	
5.80	Stress in Highway & RR Brgs.	3(5)	
5.87	Structural Design II	3(5)	
12.42	Heating & Ventilation (CEC)	2(3)	
G5.82	Shipbuilding & Ship Repair Facilities (CEC)	3(3)	21(32)
	Summer Survey		
5.16	Topographic Surveying		
5.35	Foundations (CEC)	3(5)	
5.59	Sanitary Engineering (CEC)	4(7)	
5.81	Bridge Analysis & Design	3(5)	10(17)
	Summer Survey		61 credits total
5.18	Route Survey		

This course is built around the educational bankground of Naval Academy graduates. However, two other classes of candidates will take it.

(a) Those officers who have an educational background at a civilian institution but do not posses and engineering degree. The curriculum for each such officer will have to be adjusted to fit those courses he has taken.

(b) Those officers who are already in the Corps but posses an engineering degree other than Civil, i.e., Electrical, Mechanical, etc. For those officers the course will be approximately 13 months in length and will be their "equalization course". Although their educational backgrounds will vary, they should have enough previous credits among the subjects listed to enable them to complete all of the subjects listed and obtain a BCE degree by the end of the term ending in June. All other students will receive a BCE in September of the year following their entrance in May.

COURSE PROGRAM FOR CEC STUDENTS
EQUALIZATION COURSE

	*5.32	Soil Mechanics (CEC	3(5)
	*5.35	Foundations (CEC)	3(5)
	*5.79	Reinforced Concrete II	3(5)

Electives for students who have had one of the above.

	5.50	Sanitary Engineering (CEC)	4(7)
	5.77	Structural Design I	3(5)
	5.81	Bridge Analysis & Design	3(5)
	10.11	Engineering Geology	3(4)
	*fl7.64	Trans. & Dist.	3(4)
	*5.15	Highways and Airports	3(5)
	*fl10.12	Advanced Geology	3(5)
	*flG5.30	Graduate Soil Mechanics I	3(5)
	*flG5.32	Graduate Foundations I	3(5)
	*flG5.75	Graduate Reinforced Concrete	3(5)
	*flG5.79	Graduate Structures I	3(5)
	*flG12.48-7.69	Power Plants (Theory (CEC)	4(6)
	*fl5.86	Arch. Planning Principles (CEC)	3(5)
	*flG12.48 7.081	Power Plants Design (CEC)	4(6)
	*G5.82	Shipbuilding & Ship Repair Facilities (CEC)	3(3)
	fl6.55	Personnel Mgmt. & Industrial Relations (CEC)	3(4)
either	*fl(G5.31	Graduate Soil Mechanics II	3(5)
	*fl(G5.33	Graduate Foundations II	3(5)
or	*fl(G5.78	Concrete Building Frames	3(5)
	*fl(G5.80	Graduate Structures II	3(5)
	*fl G	Thesis	4(10)

*Students taking the equalization course only and who already have a BCE of BSCE degree.
flThose students who have previously taken the qualification course.

Note that either class of students may specialize in Foundations or Structures. Students completing this course to receive an MCE Degree. Approximately 50% of the class should specialize in each.

Courses may be shifted between terms to fit schedules of school.

GENERAL LINE

One year graduate training at Newport, R. I. and Monterey, Calif.

OBJECTIVE

The objective of the General Line Curriculum is to care for the pressing need to indoctrinate, specifically train, and broaden the professional knowledge of the large number of transferred reserve and temporary officers and of Naval Academy graduates, who, during the past few years, have served in specialized assignments, and to prepare officers having three or four years of narrow experience for the early assumption of broader responsibility aboard ship.

CURRICULUM

Subject	1st Term	2nd Term	3rd Term	4th Term	Total Hours Per Year
Strategy & Tactics	3	3½	3½	3	130
Communications	2	2	2	2	80
Logistics	2	2	2	2	80
Electricity & Math*	5	5	5	5	200
Ordnance & Gunnery	4	4	4	4	160
CIC-ASW	5A	5B	5C	5D	50
Administration & Leadership	2CD	2CD	2AB	2AB	40
Naval History	1C	1D	1A	1B	10
Foundations of National Power	2B	2C	2D	2A	20
Military Law	4B	4C	4D	4A	40
Naval Intelligence	1C	1D	1A	1B	10
Aviation	2AB	2AB	2CD	2CD	40
Naval Engineering	4CD	4CD	4AB	4AB	80
Damage Control	4C	4D	4A	4B	40
Seamanship	3D	3A	3B	3C	30
Navigation	4AB	5AB	4CD	5CD	90
Meteorology	2D	2A	2B	2C	20
Submarines	½AD	--	½BC	--	5
Seamanship P.W.					10
			TOTAL HOURS		1135

* Mathematics 40 hours of first term

NOTE: The student body is divided into four (4) equal groups (A,B,C,D,) to facilitate scheduling.

NAVAL CONSTRUCTION AND ENGINEERING CURRICULUM

A three year course at Massachusetts Institute of Technology at Cambridge, Massachusetts, successful completion of which normally leads to designation of Engineering Duty Officer.

Although the curriculum is designed to qualify the student generally for naval construction and engineering assignments, selection of courses is such as to offer advanced work in any one of the following:

Basic Hull Design and Structures
Electronics Engineering
Fuels, Combustion, High Temperature Materials and Corrosion
Nuclear Engineering
Hydraulic Machinery, Propellers, and Lubrication
Ship Habitability
Internal Combustion Engines (Diesel)

Quotas for the above specializations are determined by the Chief of the Bureau of Ships.

The three year course may be shortened to two years for students having exceptional scholastic background.

All curricula lead to a Master's Degree in Naval Construction and Engineering. Details may be found in the annual Massachusetts Institute of Technology Bulletin.

NAVAL INTELLIGENCE

Twelve to twenty seven months at Anacostia, D. C.

Objective: To train Naval Officers selecting Intelligence as their specialty, in all phases of Intelligence. To conduct intensive instruction in foreign languages to meet the Navy's need for linguistic officers.

CURRICULUM

The student spends six months at the school studying intelligency subjects, then ten weeks at field work with the fleet is undertaken; and finally, a period of from three to eighteen months is spent at the school studying a foreign language. The degree of difficulty of the language determines the length of the final period.

LAW

Three years of graduate work for selected officers of the Navy in the LAW SCHOOL of George Washington University or Georgetown University.

Considerable latitude is allowed in the exact curriculum followed by the student officer within the framework essential to receiving a degree in law at the university in question. Studies at the Law School are supplemented with work in the Office of the Judge Advocate General of the U.S. Navy.

ADVANCED MANAGEMENT

A thirteen week course conducted twice each year, in February and September, by the Graduate School of Business Administration, Harvard University.

The method of instruction is by means of research studies involving inquiries of several companies or perhaps an industry, and case studies collected from specific business organizations.

The study program is divided about equally among the following subjects:

(a) Administrative Practices
(b) Cost and Financial Administration
(c) Production Management
(d) Marketing Management
(e) Problems in Labor Relations

At present tnis course is made available to only a few selected naval officers of the rank of Commander or above and departmental quotas are determined by the Bureau of Personnel.

TEXTILE ENGINEERING CURRICULUM

Two vears of graduate work for selected officers of the Supply Corps at Lowell Textile Institute at Lowell, Massachusetts.

Ihasmuch as student officers are allowed a considerable discretion in the selection of course pursued, dependent upon their individual background, it is impractical to reproduce here all the courses offered at Lowell Institute and available to officers of the Supply Corps. Courses are offered which lead to Master's degrees, provided the student has adequate educational background to pursue them satisfactorily.

Details may be found in the Annual Curriculum Bulletin of Lowell Textile Institute, available from that institution upon request.

PHOTOGRAPHY

A one year course in Photography will be given to selected officers with previous experience in this field at the University of Southern California and other schools offering courses.in this work.

BUSINESS ADMINISTRATION CURRICULUM

A two-year course of Postgraduate instruction conducted at the Harvard Graduate School of Business Administration and at the Stanford University Graduate School of Business.

Objective: To develop the ability in officers to analyze business organizations, problems, and conditions; to acquire an appreciation for and an understanding of business as a whole; and to administer effectively future assignments which may require personal dealings with business and industrial concerns or utilization of business techniques.

University bulletins should be consulted for details of the curricula. In general, officers take courses recommended by faculty advisors at the two schools. The advisors are in close contact with representatives of the various technical Navy Department Bureaus which have officers enrolled and endeavor to have student officers take courses best suited to the respective Bureau's requirements. The curricula outlined below are samples only and are purposely made sufficiently flexible to meet varied requirements:

STANFORD

FIRST YEAR

Autumn Quarter

Sources of Business Administration
Business Reports
Business Economics
Management Accounting
Business Organization

Winter Quarter

Cost Acounting
Business Finance
Business Statistics
Business Psychology

Spring Quarter

Business Finance
Business Forecasting
or
Applied Business Statistics
Marketing I
Industrial Management I

HARVARD

FIRST YEAR

Autumn Semester

Single Course, Elements of Administration, divided into six parts:
Production
Marketing
Finance
Control
Administrative Practices
Public Relationships and Responsibilities

Spring Semester

Continuation of same divided single course as outlined in Autumn Semester.

BUSINESS ADMINISTRATION CURRICULUM (Continued)

STANFORD

SECOND YEAR

Autumn Quarter

Auditing
Marketing
Industrial Management
Retail Store Management
or
Production Engineering

Winter Quarter

The Law of Contractual Relations
Production Management
Purchasing
Accounting Organization and Comptrollership
Market Research
or
Personnel Administration

Spring Quarter

Business Forecasting
or
Interpretation of Business Data
Industrial Cost Control and Budgeting
Accounting Problems
Quality Control of Statistical Methods

HARVARD

SECOND YEAR

Autumn Semester

Administrative Policy I
Industrial Accounting I
Transportation
Industrial Procurement

Spring Semester

Administrative Policy II
Industrial Procurement
Industrial Accounting II
Personnel Administration

PERSONNEL ADMINISTRATION AND TRAINING CURRICULUM

A four-quarter (12-month) course of instruction carried on at three Universities, Ohio State, Northwestern, and Stanford.

The curricula at the different universities differ in themselves and are adaptable to the individual backgrounds of the students concerned. Considerable elective make-up of personal curricula is allowed and so the course outlined below should be considered as illustrative of the general coverage of the course rather than accurate as to the details, which vary from University to University and between individual students.

Name of Course	Grade Units
Educational Scoiology	4
General School Supervision	4
General Psychology	5
Occupational Hygiene	4
	17
Seminar Military Personnel	5
Statistical Methods	5
Business Reports	1
Business Organization	5
	16
Seminar Military Personnel	5
Social Psychology	3
Industrial Relations	4
Personnel Administration	4
	16
Seminar Military Personnel	5
Public Speaking II	2
Industrial Psychology	3
Abnormal Psychology	5
	15

MANAGEMENT AND INDUSTRIAL ENGINEERING CURRIVULUM

One academic year at Postgraduate Education at Rensselaer Polytechnic Institute, Troy, New York.

Latest BuPers Circular Letter on "Applications for Postgraduate Training" should be consulted to determine eligibility.

First Term

Cost Analysis and Control	3-5
Motion Economy in Industrial Production	3-5
Production Planning and Control I	3-5
Personnel Organization and Management	3-4
Thesis	3-0
	15-19

Second Term

Statistical Analysis	3-5
Industrial Performance Standards	3-5
Production Planning and Control II	3-5
Industrial Relations	3-4
Thesis	3-0
	15-19

This course leads to a degree of Master of Science. (Undesignated)

OCEANOGRAPHY CURRICULUM

Two semesters of graduate work in oceanography at Scripps Institute of Oceanography followed by three months at the U. S. Naval Hydrographic Office.

The exact course followed at Scripps will vary with the student officer and be planned by consultation between the Hydrographic Office and Scripps Institute.

RELIGIOUS CURRICULUM

Selected chaplains are selected each year to pursue advanced studies in religious and pastoral subjects. The choice of subjects is left largely to the individual concerned; courses vary widely from college to college depending upon the previous background and denominational training of the chaplains concerned.

The schools cooperating with the Navy in this program are:

The Catholic University of America
Fordham University
Harvard University
The Pacific School of Religion
Union Theological Seminary

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